CHARACTERISTICS AND HABITAT REQUIREMENTS OF THE GREATER PRAIRIE CHICKEN AND SHARP-TAILED GROUSE— A REVIEW OF THE LITERATURE

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INTRODUCTION

Greater prairie chickens and sharp-tailed grouse are members of the grouse family, Tetraonidae. Nine species in seven genera of grouse are native to North America, compared with eight species in five genera in other parts of the world. Only two species, the willow and rock ptarmigans (*Lagopus lagopus* and *L. mutus*), are found in both the new and old worlds (Aldrich 1963).[1]

Prairie chickens belong to the common genus *Tympanuchus*. The species *T. cupido* includes the heath hen, *T. c. cupido* (Linnaeus),[2] now extinct; the greater prairie chicken, *T. c. pinnatus* (Brewster); and Attwater's prairie chicken, *T. c. attwateri* Bendire. The species *T. pallidicinctus* (Ridgway) includes only the lesser prairie chicken.

Six subspecies of sharp-tailed grouse are found in North America, all belonging to the common species *Pedioecetes phasianellus*. They are: *P. p. phasianellus* (Linnaeus), the northern sharp-tailed grouse; *P. p. kennicotti* Suckley, the northwestern sharp-tailed grouse; *P. p. caurus* Friedmann, the Alaska sharp-tailed grouse; *P. p. columbianus* (Ord), Columbian sharp-tailed grouse; *P. p. campestris* Ridgway, the prairie sharp-tailed grouse; and *P. p. jamesi* Lincoln, the plains sharp-tailed grouse (American Ornithologists' Union 1957, Aldrich 1963).

In North America, the sharp-tailed grouse has been given many common names: Prairie chicken, prairie hen, brush chicken, wild chicken, fire grouse, sharptail, pintail, pin-tailed grouse, sprig-tailed grouse, and brown legs (Ammann 1957, Edminster 1954, and Hart et al. 1950).

Much current research on greater prairie chickens and sharp-tailed grouse is listed under the general heading "prairie grouse," because of the overlap in the distributional range and their similar habits. The name "prairie grouse" in this paper refers to both the sharp-tailed grouse and the greater prairie chicken. Also, "sharptail" is synonymous with sharp-tailed grouse, and "prairie chicken" refers to the greater prairie chicken unless otherwise indicated.

Many of the specific habitat requirements for these two grouse are unknown. Their populations can be increased only through effective management practices based on adequate knowledge of specific habitat requirements. With this review of the literature covering work on the habits and habitats of prairie grouse, new projects can be carefully planned to yield needed information and yet not duplicate past studies.

GREATER PRAIRIE CHICKEN

HISTORY

Aldrich (1963) reported that differentiation of both species and genera of the grouse family has been extraordinary in the relatively limited geographical area of North America. Skeletal elements discovered in Newton County, Ark., indicate that the genus *Tympanuchus* existed during the Pleistocene Epoch. These remains were of a bird classified as *Tympanuchus ceres,* which stood about 16 inches high, with a heavier bill, smaller and shorter wings, and more slender legs than existing prairie chickens. This species (*T. ceres*) appeared to be related in origin to the lesser prairie chicken, but not directly in the evolutionary line of development (Wetmore 1959).

The greater prairie chicken has acquired many common names, a few of which are: prairie chicken, prairie hen, squaretail, sage chicken, yellow legs, and pinnated grouse.

Before settlement, greater prairie chickens were confined primarily to the tall grass prairies. Prairie chicken populations thrived with white man's first attempts at farming. Research in Iowa illustrates the trend in prairie chicken numbers as agricultural practices became more intensive throughout the tall-grass prairie States. The prairie chicken population reached a peak in Iowa in about 1880 when 69 percent of the State was classed as farmland. This peak in prairie chicken numbers was brought about by the abundance of undisturbed nesting areas in "prairie-type" land intermingled with patch farming. By 1900, 90 percent of Iowa was being farmed, and consequently prairie chicken numbers were decreasing. A few prairie chickens remained within the State on the poorly drained grasslands until the early 1950's. Since then, only an occasional bird has been reported (Stempel and Rodgers 1961).

Greater prairie chickens were scarce or entirely absent on much of the western Great Plains in presettlement days, but became abundant soon after cultivation was started (Beck 1957). They were first definitely recorded in Colorado in 1897 by J. S. Robertson, who observed the birds in the extreme northeast corner of the State (Sclater 1912). Their range gradually extended westward as the native sod gave way to farms and wheat fields (Cooke 1909). Prairie chicken populations then flourished until the dust bowl days of the 1930's, when many of the small ranches and farms were abandoned or incorporated into larger holdings, which led to large areas of intensive cultiva-

[1] Names and dates in parentheses refer to Literature Cited (from Bibliography), p. 24.

[2] Scientific names of grouse and the form used for noting authority are in accordance with American Ornithologists' Union (1957).

tion on the better soils. Grasslands were maintained only where the soil was too sandy or the land too hilly to farm. With very little winter food on the grasslands, and virtually no nesting cover on the farmlands, prairie chicken numbers decreased drastically. Since the 1930's, prairie chickens have become less abundant on all areas of former habitat in Colorado (Evans and Gilbert 1963).

Prairie chickens were first recorded in North Dakota in the early 1880's. In the next 20 years populations increased and spread throughout the State, remaining high during the "good pinnate years" between 1900–1930, then decreasing drastically during the 1930s. By 1964, an estimated 4,000–5,000 birds remained in North Dakota, along the western edge of the Red River Valley (Johnson 1964).

Prairie chicken numbers followed this same pattern over much of the Great Plains. As the homesteaders settled and raised cereal crops on small areas, populations increased. When cultivation became intense and grassland decreased, or when farms were abandoned and no cereal crops raised, their numbers decreased drastically.

In the northern Great Lake States, extensive logging fires and small patch farming created suitable habitat for prairie chickens, and their numbers increased. The grasslands and openings which were created are now becoming reforested due to a combination of abandoned farms and natural plant succession. As forests have reinvaded, prairie chickens have decreased (Edminster 1954).

PRESENT DISTRIBUTION

Prairie chickens now occupy the grasslands of the central United States and south-central Canada with the center of distribution between the Missouri and Mississippi Rivers at approximately 40° North latitude. The range includes southern Alberta, Saskatchewan, and Manitoba; North and South Dakota, Minnesota, Michigan, Nebraska, Iowa, Illinois, most of Indiana, northwestern Ohio, Kansas, most of Missouri, Oklahoma, eastern and northern Texas, and parts of eastern Montana, Wyoming, Colorado, and New Mexico (Greenway 1958). The American Ornithologists' Union (1957) reported approximately the same distribution, but added southern Ontario. Aldrich (1963) described past and present distribution (fig. 1).

DESCRIPTION

The greater prairie chicken is a hen-sized grouse identifiable by its rounded tail and heavily barred underparts. Males average 2 pounds, 3 ounces, females approximately one-half pound less (Sprunt and Zim 1961). Although the general color of the prairie chicken is a drab brown, a red phase has been reported (Brewster 1895). All members of the grouse family have feathered tarsi (lower legs).

The prairie chicken has erectile neck feathers or "pinnae," hence the name pinnated grouse. The females have shorter pinnae, and barring on all 18 rectrices (tail feathers), whereas the males have longer pinnae and barring only on the center rectrices (Mosby 1960, fig. 2). Males can be distinguished from females in the spring by the large orange tympani (air sacs) on their necks, which protrude during the courtship display (fig. 3).

Attwater's prairie chicken is very similar in appearance to the greater prairie chicken, while the lesser prairie chicken is smaller and generally paler in color than its two relatives. The bars on the back of the neck are solid black in both the greater and Attwater's prairie chicken, but on the lesser species these bars have a broad brown center with narrow black edges (Lehmann 1941). The air sacs on the males are reddish in the lesser species and orange in the greater species.

LIFE HISTORY

Courtship and mating.—With the advent of warmer weather in late winter or early spring, male prairie chickens leave the winter flocks and begin visiting display grounds or "booming grounds." Display grounds are often occupied as early as January, but activities are feeble and infrequent until early spring, when the males gather regularly each morning and evening. The morning display begins about one-half hour before sunrise and lasts 2 to 4 hours. The evening display begins about 1 hour before sunset and continues until dusk (Edminster 1954, Schwartz 1944).

Most display grounds are located on open ridges, grassy knolls, or slight rises of the topography. Prairie chickens return to the same general location each year for their displays. Some booming grounds in Missouri have been occupied every spring for at least 40 years (Schwartz 1944). Although most are located on permanent grassland with sparse shortgrass vegetation, some have been used after the area was cultivated or a road constructed across it (Bjorgen 1963).

The following account of prairie chicken "booming" is summarized from Schwartz (1944): The male runs forward a short distance, stops, and stamps its feet rapidly in a dance—sometimes pivoting in a half or full circle. During the dance, its brilliant orange air sacs (tympani) begin to inflate and the long neck feathers (pinnae) are erected. Its tail, spread fanwise, snaps suddenly with a sharp "click" and the air sacs are deflated, producing the "boom," which can be heard up to 1 mile distant on a calm morning. The stamping of the feet can be heard up to about 30 yards.

The quality of the "boom" is like that of the lower note of an ocarina, or the sound made by blowing across the open neck of a bottle. The fully developed "boom" includes three notes which rise at even intervals of a quarter- or half-tone. The call has a ventriloquial effect; thus, it may sound closer or father away than it really is. The sound of the "boom" has been described by several authors:

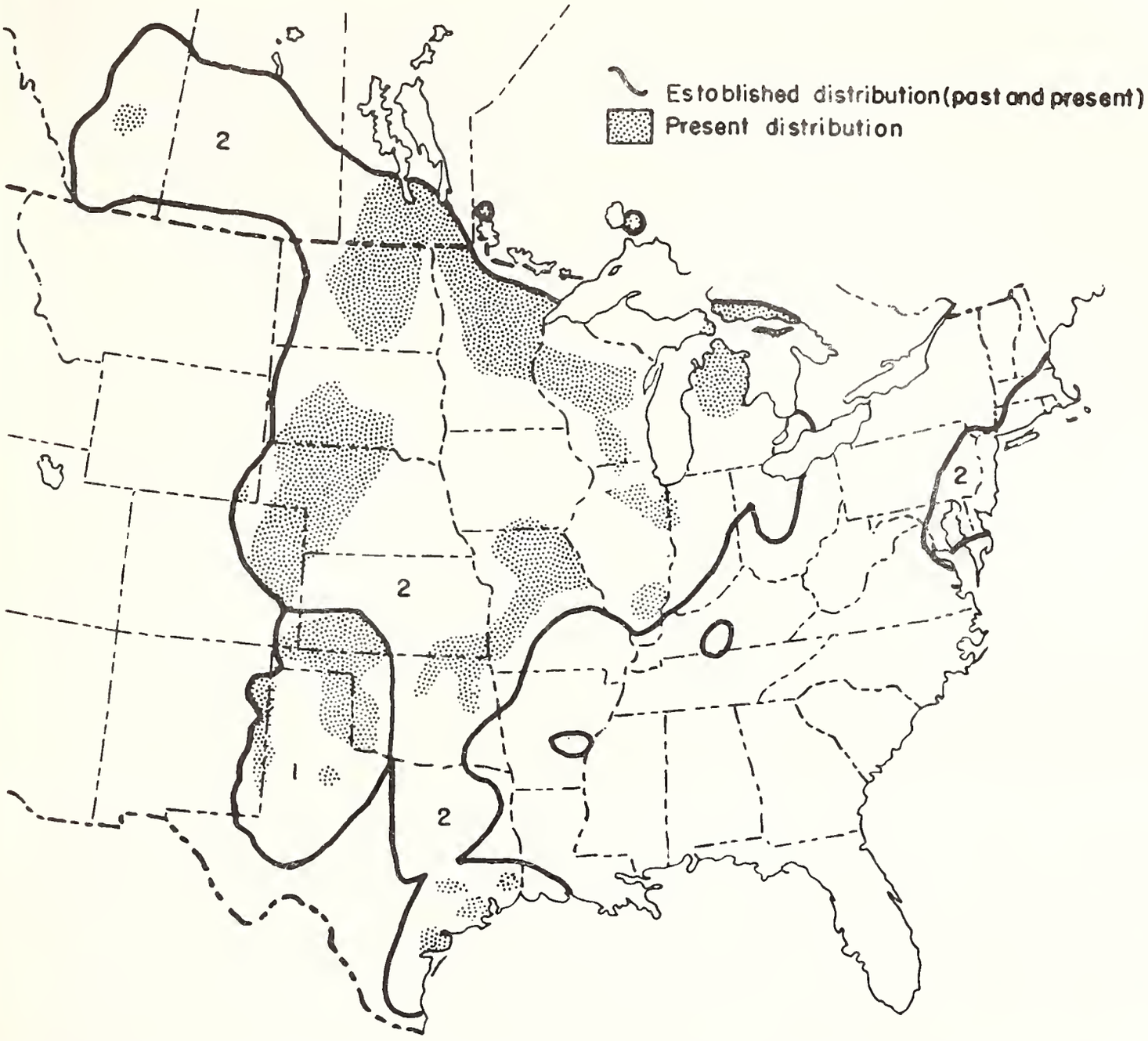

Figure 1.—Past and present distribution of prairie chickens in North America: (1) Lesser prairie chicken, and (2) greater prairie chicken, including the extinct heath hen, formerly of New England, and Attwater's prairie chicken of the Texas Gulf Coast (Aldrich 1963).

Sound	*Source*
C-A-O-O-O-O-O, H-O-O, H-O-O	Stoddard 1922
Old mul doon	Ammann 1957
Zooooo-Woooo-Youoo	Grange 1940
oowoo-woo-woo	Lockart 1960
Durned old f-o-o-l	Viehmeyer 1938
Boom-a-boom	Tolman 1962
oo-LOO-Woo	Schwartz 1944

On the booming ground, each male establishes a territory, about 10 yards from its nearest neighbor, and does most of the booming and mating within its territory (Schwartz 1944). Hamerstrom and Hamerstrom (1960) listed the functions of booming as follows: (1) To advertise the display ground, and thus facilitate mating; (2) as an act of aggression, including territorial defense; (3) to release pent-up energy; (4) as a courtship display; and (5) as a means of sexual recognition.

Display grounds are considered an essential element in the mating habits of prairie chickens. Most matings take place during the peak of courtship, usually the last 2 weeks in April. Display activities and occasional matings extend into early June. Perhaps some late matings are results of renesting attempts by females. Leopold (1933) indicated that prairie grouse are probably promiscuous in their breeding habits.

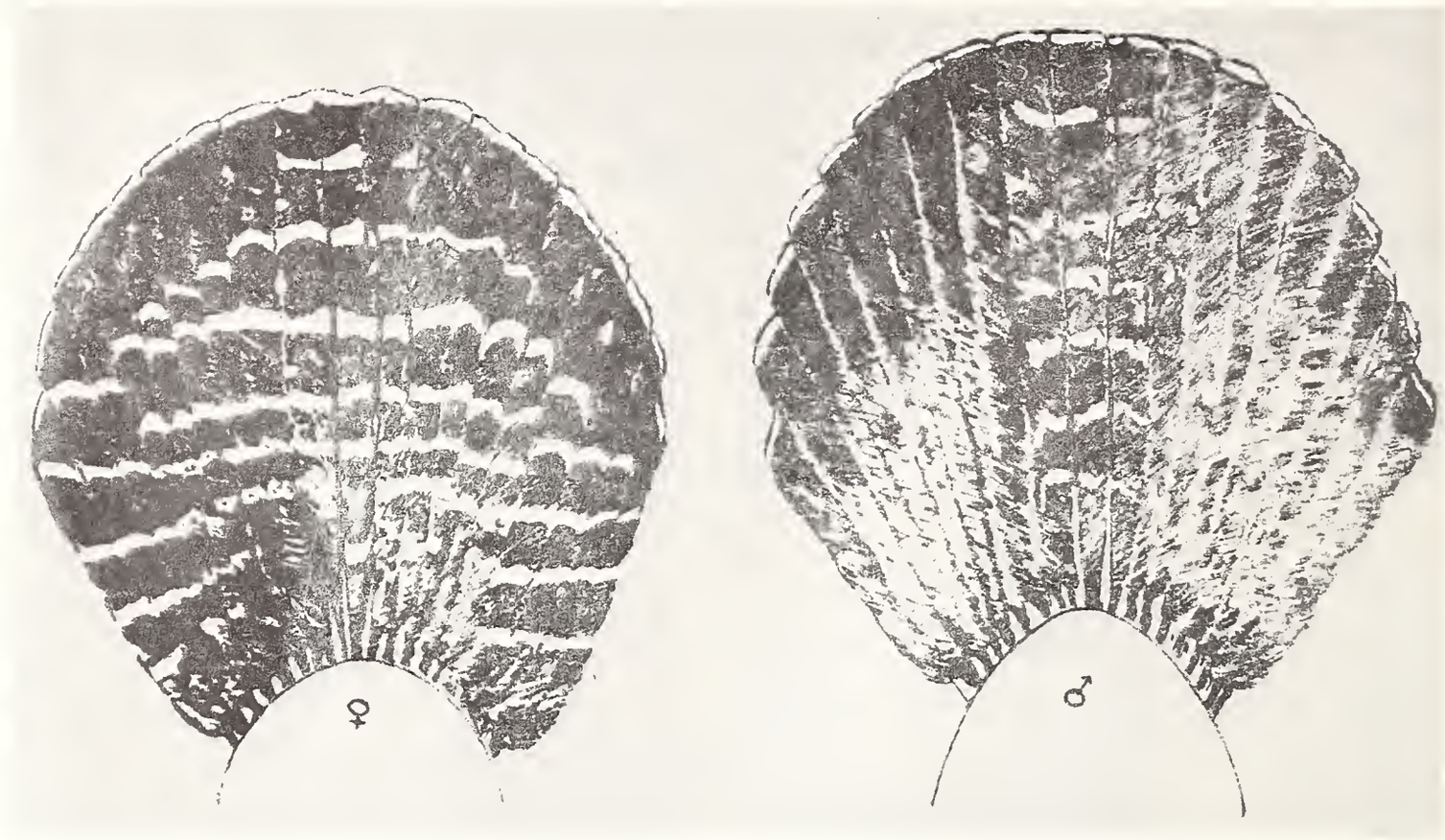

Figure 2.—The rectrix pattern in the tail feathers of prairie chickens provides a means of distinguishing between the sexes. The tail of the female (*left*) has barring on all rectrices, whereas the male has barring only on the center rectrices (after Thompson in Mosby 1960).

Figure 3.—Greater prairie chicken male (*left*) in displaying position alongside female.

In the autumn, male prairie chickens resume their visits to the display grounds. They gather in the morning on most of the grounds used in the spring. Females appear occasionally and spend most of their time preening; no attempts at mating are made. The grouse usually fly from the display grounds simultaneously to feed in nearby fields (Schwartz 1944, Bjorgen 1963). Early in September, the males have not completed their molt; as each bird completes its molt, booming and dancing activities increase in vigor. The air sacs and eyebrows of the birds become brilliantly colored much as they do in the spring. The establishment of territories is also a gradual process in the fall, but by mid-November nearly all the males have a territory. They use the same calls and fighting behavior as in the spring.

Nesting.—Females begin nesting activities at the height of the courtship display in the spring. Nests are usually within a mile of the booming ground. There is generally open water not more than a mile from the nesting site.

The ground nest consists of a depression lined with plant material and feathers (Hamerstrom 1939, Trippensee 1948). A nest which the author found in 1963 in the sandhill type in Colorado was approximately 12 inches in diameter and 4 inches deep.

Grassland appears to play an important role in the nesting habits. Hamerstrom (1939) found 22 out of 23 nests in grassy areas along drainage ditches, dry marshes, and grass-covered openings within woody vegetation. Trippensee (1948) reported that 95 percent of all prairie chicken nests were located in grassland. Nine nests found on a 254-acre study area in Oklahoma were close to either cultivated pastures or old fields characterized by short vegetation with an abundance of forbs (Jones 1963b).

Time of nesting is variable, depending on the latitude and the incidence of warm spring weather. Nest construction commonly begins April 16–30. It is generally believed that prairie chickens seldom renest, although it has been reported that a hen may lay a second clutch of eggs if the first is destroyed (Erickson and Petraborg 1952).

Eggs and incubation.—Prairie chicken eggs vary in color from a dark olive-buff to a grayish olive or tan, sometimes spotted with brown dots, and average 45 mm. long by 34 mm. broad (1.75 inches by 1.25 inches) (fig. 4). Observations of prairie chicken nests revealed an average of 12 eggs per clutch, with an incubation period of 23 days (Bent 1932, Edminster 1954, and Reed 1965). Edminster (1954) states that one egg per day is the normal laying rate; Gross (1930a) states that one egg is laid every 2 days. Eggs hatch in June and July, with the peak between June 1 and June 15 (Hamerstrom 1939).

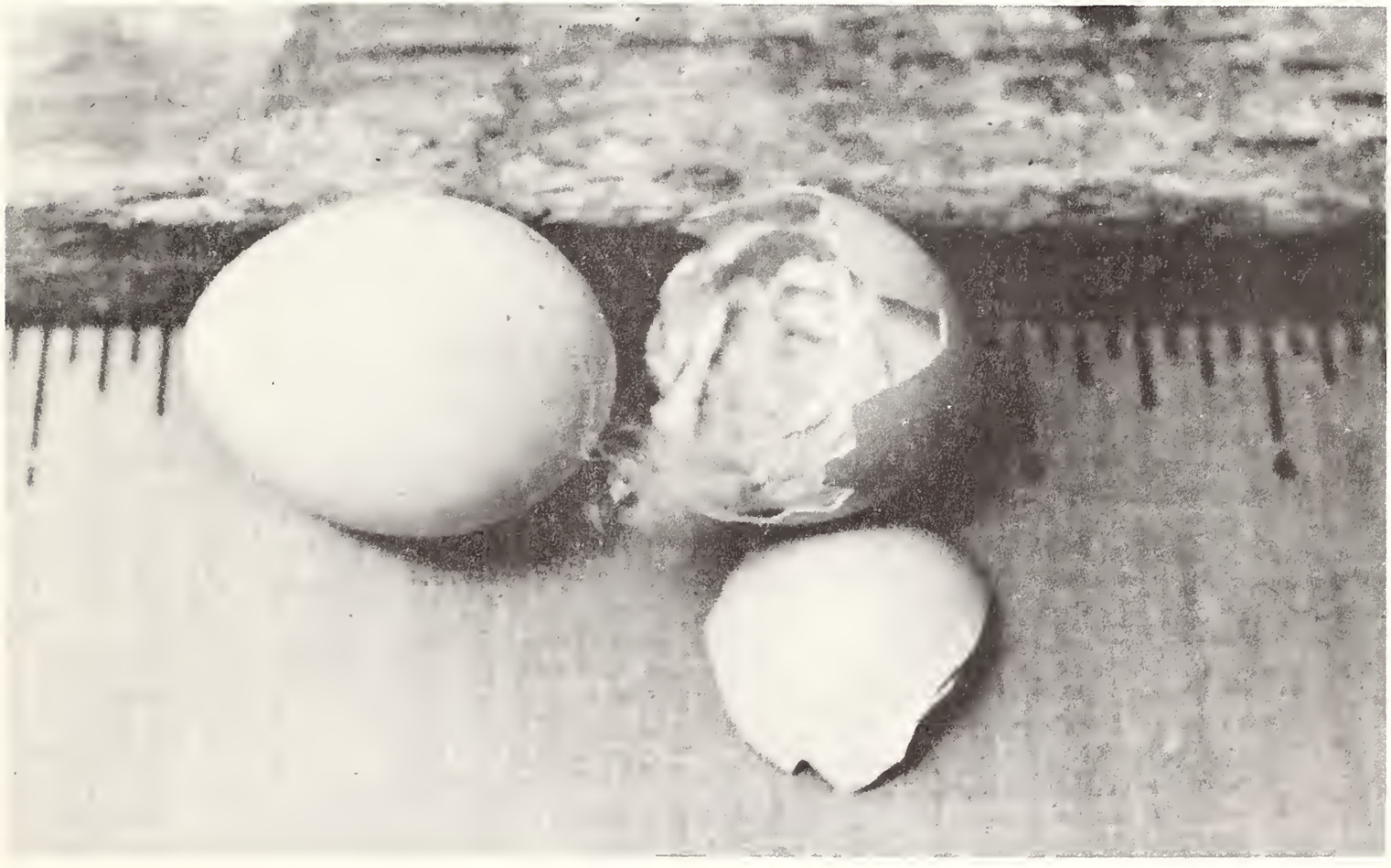

Figure 4.—Unhatched and successfully hatched eggs of greater prairie chicken.

Young.—Nesting success is approximately 50 percent, but may be much lower:

Area	*Nest success*	*Source*
	Percent	
North Dakota	25	Miller 1947
Wisconsin	50	Gross 1930a
Wisconsin	50	Hamerstrom 1939
Wisconsin	25	Bent 1932
Illinois	49	Yeatter 1943

Average brood size at hatching is 11 birds, but before the chicks are full-grown the brood usually decreases to an average of six during good years and less during poor seasons (Edminster 1954).

Young prairie chickens are pale yellow, with brown to black spots and blotches on the back, neck, and top of the head. The legs are covered with down.

The precocious young prairie chickens are ready to leave the nest as soon as their down dries. During the first day of the chick's life it is brooded a great deal, but before long becomes active in searching for insects and other food (Bent 1932). The chicks are flightless for 10 days, and will hide or "freeze" when in danger (Edminster 1954).

By September young prairie chickens appear to be full-grown. Baker (1953) reported weights of 89 young prairie chickens killed during an October hunting season in Kansas. These weights ranged from 650 to 1,050 grams, averaging 853 grams. This is compared with a range of 750–1,100 grams and an average of 911 grams for adult prairie chickens collected at the same time. The average weight of young males was reported to be 926 grams, whereas young females averaged only 777 grams.

Movements.—Over most of their range, prairie chickens are considered non-migratory, however, records indicate that they have migrated from northern segments of their range southward in winter. Seasonal movements are longer in the northern habitats than in the southern range. Prairie chickens in the northern part of the range will move as far as 300 miles southward for the winter (Bent 1932).

In the late 1800's, W. W. Cooke (in Bent 1932) reported that in November and December large flocks of prairie chickens from Minnesota and northern Iowa migrated south to Missouri and southern Iowa. The intensity of migration varied with the severity of the winter. Similar migration patterns are reported for North Dakota and Wisconsin. Where cultivation has made cereal grains available, length of migration has decreased (Johnson 1964, Trippensee 1948, and Bent 1932).

Prairie chickens inhabiting the central and southern portions of the range are permanent residents. If long movements occur, they are in the direction of cultivated crops, and not necessarily north-south migrations. Viehmeyer (1938) believed that the only major cause of fall migrations of Nebraska's prairie chickens was the lack of winter food.

Flocks of migrating prairie chickens are composed primarily of females and young birds. The males tend to remain near the display grounds throughout the winter.

Sex and age ratios.—Relatively little material has been published on sex or age ratios for prairie chickens. In Nebraska, sex and age data on more than 1,000 prairie chickens were recorded during six fall hunting seasons (table 1). Age data indicate an average of 1.8 young per adult, and 3.6 young per adult hen. Sex ratios averaged 107 males per 100 females (Robertson 1966, Menzel 1962, Walstrom 1960, Walstrom and Linder 1959, and Heebner 1957a and b).

Table 1.—*Sex and age ratios of prairie chickens harvested during fall hunting seasons in Nebraska* [1]

Year	Young		Adult	
	Male	Female	Male	Female
1956	1	14	6	20
1957	10	20	0	6
1958	68	95	14	15
1959	169	100	120	88
1961	50	55	16	20
1965	69	48	37	44
Total	367	332	193	193

[1] Summarized from Robertson 1966, Menzel 1962, Walstrom 1960, Walstrom and Linder 1959, Heebner 1957a and b.

Interspecific competition.—Many ranchers believe that pheasants compete with prairie chickens and eliminate them from grassland. Biologists, however, report very little or no discord. Pheasants and prairie chickens have been observed feeding in the same field with no conflict (Mohler 1952). Carlson (1942) saw a male prairie chicken courting two female pheasants with two male pheasants in the immediate area. One of the male pheasants ran off the other, but treated the male prairie chicken indifferently. Hybridism between *Phasianus* and *Tympanuchus* was detected by Harger (1956). Harold M. Swope, Colorado Department of Game, Fish and Parks (personal communication), observed on several occasions a male prairie chicken and a cock pheasant on booming ground areas with no apparent conflict or intolerance.

Harger (1956) reported that a male pheasant was heard crowing about a quarter of a mile from a booming ground. Later it approached the booming ground and ran three male prairie chickens away, one at a time. One might theorize that the cock pheasant was intent on driving rivals away from its harem. On the other hand, the male pheasant might have mistaken these relatively drab birds for female pheasants.

Occasionally, prairie chicken numbers have declined and sharptails have become abundant during the same period and in the same area. This change in grouse composition has generally been attributed to habitat changes. In a discussion of nine areas in Michigan where sharptails replaced prairie chickens, Ammann (1957) believed the replacement took place more rapidly and completely than would be expected if habitat changes alone were responsible.

Interspecific and intraspecific competition is one area of prairie grouse study that merits more research.

FOOD HABITS

Prairie chickens, like other members of the grouse family, are primarily herbivorous except in the juvenile stage, when as much as 80 to 90 percent of the diet is animal material, mostly insects. Adult prairie chickens probably consume more insects than do adults of other grouse species. Prairie chicken food habits vary greatly between areas and seasons (table 2). The summer diet consists mainly of wild greens and insects. By fall the birds have shifted to a diet that includes a large amount of cultivated grains. Grain is a major part of the diet throughout the winter and spring until native plants and insects become available (fig. 5).

Schmidt (1936) listed the following as characteristic of the prairie chicken diet in Wisconsin: (1) Preferred foods eaten before snowfall include buckwheat, barley, oats, ragweed, smartweed, and rye; (2) staple foods eaten after snowfall are corn and the buds of hazel, white birch, bog birch, aspen, and black birch; (3) emergency foods are the buds of maple, elm, willow, pine, and apple; (4) mineral, tonic, or vitamin foods are weed seeds, rose hips, hay, sorghum, and green leaves; and (5) gravel and rose stones are used for grit.

Table 2.—*Summary of the food habits of the greater prairie chicken from various sources*

Main food	Geographic area	Source
Insects, leaves, fruits, seeds, and waste grain.	General	Sprunt and Zim 1961
Corn, knotweed, oats, wheat, rose, blackberry, and grasshoppers.	Northern prairies	Martin et al. 1951
14 percent animal—chiefly grasshoppers. 86 percent plant—seeds, fruits, grain, leaves, and flowers.	Middle West	Judd 1905
Grasshoppers, ragweed, oats, clover, black bindweed, acorns, greenbrier, dogwood, crickets, and buckwheat.	Wisconsin	Bent 1932
Buckwheat, soybeans, barley, oats, ragweed, acorns, corn, and buds of browse species.	Wisconsin	Trippensee 1948
Corn, soybeans, cane, Korean lespedeza, wheat, oats, sedges, and ragweed.	Missouri	Korschgen 1961
Buds, corn, cane, lespedeza, insects, and green leaves.	Missouri	Schwartz 1944
Corn, sorghum, oats, wheat, legumes, and unidentified dicotyledons.	Kansas	Baker 1953
Lespedeza, sorghum, ragweed, wheat, grass leaves, and insects.	Oklahoma	Jones 1963b

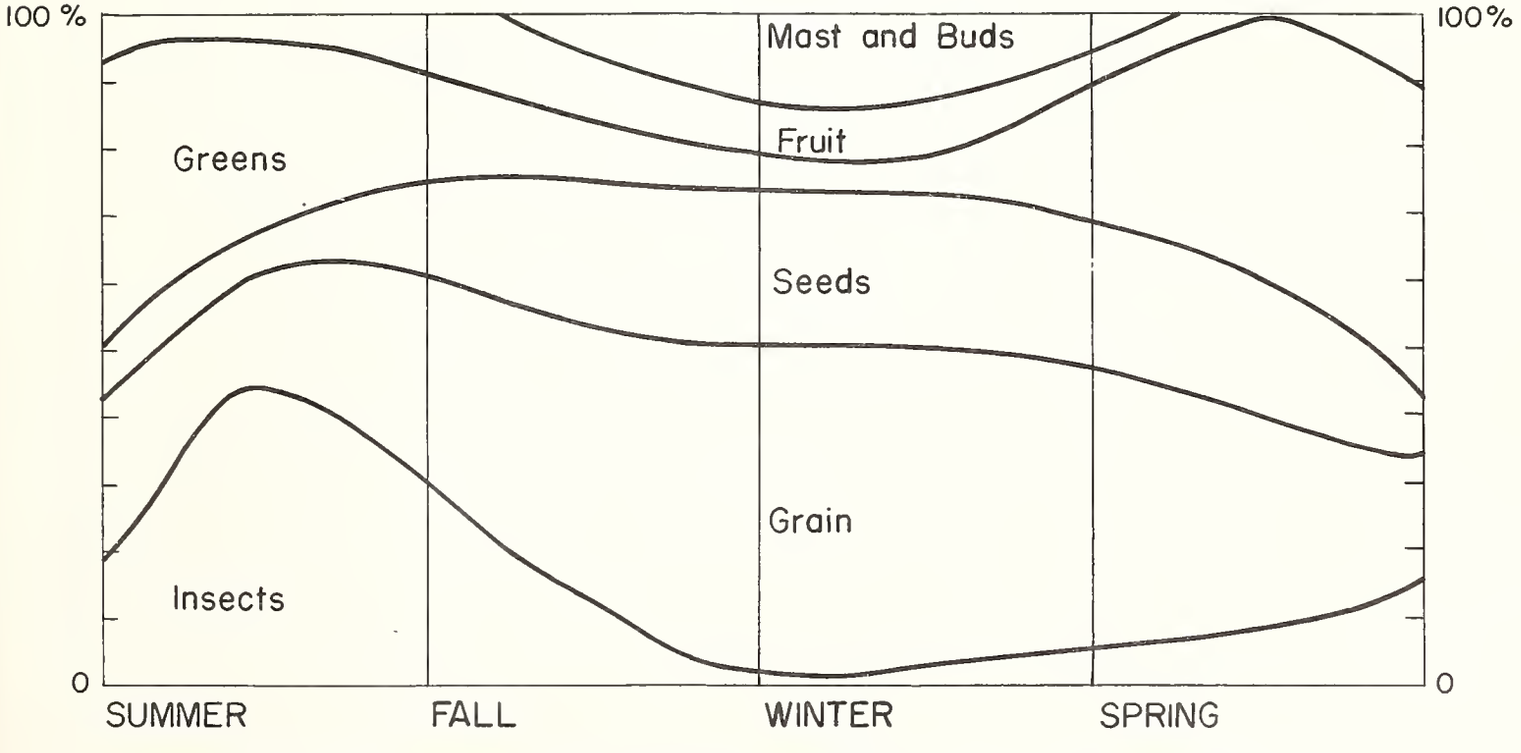

Figure 5.—General summary of the seasonal food habits of the greater prairie chicken (Edminster 1954).

DECIMATING FACTORS

Weather.—Weather conditions during nesting are important in determining the number of young birds available for the fall hunting season. A series of torrential cloudbursts followed by a long, cold, rainy period during the first 2 weeks of June will cause heavy brood mortality (Bent 1932, Shelford and Yeatter 1955). Although weather significantly influences the distribution and activities of prairie chickens, to adequately appraise its part in controlling population numbers is difficult.

Predation.—Little is known of the role of the predator in reducing prairie chicken populations, although many predatory species have been blamed for limiting their numbers. Those suspected include coyote, bobcat, fox, weasel, mink, hawk, owl, skunk, crow, and feral dogs and cats (Johnson 1964). However, studies on game-predator relationships have shown that predation is not a serious decimating factor in most areas. Some adult birds are taken by predators, and some nests are destroyed by snakes, crows, magpies, skunks, and coyotes.

In Nebraska, Mohler (1952) observed prairie chickens flushed by prairie falcons, American rough-legged hawks, and marsh hawks on 17 occasions, with no kills observed.

In Wisconsin, 4,745 blind-mornings were spent watching prairie chickens on their booming grounds during the springs of 1939–1963. Nearly 1,500 encounters between prairie chickens and potential predators were observed. Only four kills were noted, one by domestic dog and three by raptors (birds of prey). Evidence indicated that raptors may have killed six additional birds. Even though it would seem that prairie chickens on booming grounds are exposed so as to be easy prey, few predators are able to catch a healthy prairie chicken (Hamerstrom et al. 1965; Berger et al. 1963).

Man's role.—Man's variable activities cause considerable disturbance to prairie chickens. Telephone, electric, and telegraph lines and wire fences are responsible for heavy losses among low-flying birds (Stempel and Rodgers 1961). Farming operations such as haying and summer fallowing sometimes result in mortality and destruction of nests. A few prairie chickens are killed by automobiles along highways. Blus (1965) reported that 10 out of 13 eggs in one prairie chicken nest were destroyed by the hen as it flushed from the nest. The hen was flushed several times, and each time would fly directly from the nest without first moving to a standing position.

Indiscriminate and widespread annual burning of hay land to remove dead vegetation is detrimental not only to prairie chickens but to the soil as well (Schwartz 1944). Burning pastures to encourage spring grass development destroys many nests and young birds (Trippensee 1948).

Before the turn of the century, market hunters shot vast numbers of prairie chickens. It is impossible to estimate the number of birds killed between 1850 and 1930. In 1874 alone, 300,000 prairie chickens were shipped from southeast Nebraska to eastern markets (Schildman and Miller 1956). Seventy meat markets in Chicago moved over 600,000 grouse across their retail counters in 1873 (Johnson 1964).

At present, prairie chickens are hunted in only five States. The magnitude of the kill varies from year to year. Few figures are available on the harvest of prairie chickens by hunters. Kansas reported a kill figure of 88,000 prairie chickens in 1959. Nebraska and South Dakota estimate an annual prairie grouse harvest, including sharptails, of 16,000 and 15,000 birds respectively (Henderson 1965, Johnson 1964, and Menzel 1962).

Disease and parasites.—Little work has been done to determine the loss of prairie chickens due to disease or parasites. Many parasites have been reported, but none of these have been shown to cause significant mortality (Edminster 1954). Table 3 lists the endoparasites that have been found in prairie grouse. The ruffed grouse has been included in this table because more work has been done on this species, and parasites that infect ruffed grouse may also infect prairie grouse.

HABITAT REQUIREMENTS

Permanent grassland is essential for prairie chicken survival. These birds require flat to rolling areas free from excessive woody cover. Essential habitat components are provided by areas of various size, depending on the site and current land use practices. Relatively small areas are needed where tall grass prairies are available. Throughout the Great Plains and northern Lake States, larger areas are needed to provide the essential habitat components, including an interspersion of grainfields for winter food.

At the present time, prairie chickens inhabit areas that support vegetation of four main types: sandhill prairie, mixed grass prairie, tall-grass prairie, and Lake States forests.

Sandhill prairie.—Much prairie chicken habitat in Nebraska, and virtually all suitable prairie chicken habitat in eastern Colorado, is sandhills where little bluestem, sand bluestem, prairie sandreed grass, and needle-and-thread grass are abundant (fig. 6). The western edge of the sandhills contains a large amount of sand sagebrush. Most of the area is rangeland, but small isolated blocks of nearly level ground are farmed. Due to the small amount of precipitation, vegetation of good nesting and roosting quality usually exists only in swales. The amount of precipitation increases from west to east; therefore, the more lush vegetation is toward the eastern edge of the sandhills.

Prairie chickens need cereal grains for winter food throughout the sandhills. Such food is scarce in areas where the topography is too rough or the

Table 3.—*Endoparasites found in sharp-tailed grouse, prairie chickens, and ruffed grouse* [1]

Species	Definitive host [2]	Intermediate host	Location
PHYLUM PROTOZOA			
CLASS MASTIGOPHORA			
Histomonas meleagridis	R	—	Liver and caecum (Enterohepatitis or blackhead)
Trichomonas bonasae	R	—	
Trichomoniasis gallinea	R	—	Mucous membrane of throat, also liver ducts and pancreas
Trypanosoma sp.	R	Arthropod	Blood
CLASS SPOROZOA			
Eimeria angusta	RS	—	Small intestine (coccidiosis)
E. bonasae	R	—	Caecum
E. dispersa	RSP	—	Small intestine
E. sp.	SP	—	—
Leucocytozoon bonasae	R	Black fly	Blood
L. sp.	RS	—	—
Plasmodium sp.	R	Mosquito	Blood (Avian malaria)
Haemoproteus sp.	R	House fly	Blood
CLASS TREMATODA			
SUPERFAMILY BRACHYLAIMOIDEA			
Brachylaemus fuscatus	R	Snail-snail	Caecum
Harmostomum pellicidum	R	—	Caecum (probably *Brachylaemus*)
Brachlecithum orfi	R	Snail-insect	Gall bladder
Lyperostomum monenteron	R	Snail-arthropod	Gall bladder
SUPERFAMILY ECHINOSTOMATOIDEA			
Echinostoma revolutum	R	Snail	Small intestine
Echinoparyphium aconiatum	R	Snail or tadpole	Small intestine
CLASS CESTODA			
FAMILY DAVAINEIDAE			
Davainea proglottina	R	Slug	Small intestine
Raillietina tetragona	R	House fly	Small intestine (large tapeworm)
FAMILY HYMENOLEPIDIIDAE			
Hymenolepis microps	R	Insect	Small intestine (small tapeworm)
H. sp.	R	—	Small intestine
FAMILY DILEPIDIDAE			
Choanotaenia infundibulum	RSP	—	Small intestine
PHYLUM NEMATHELMINTHES			
SUPERFAMILY ASCAROIDEA			
Heterakis gallinae	RSP	—	Caecum (associated with blackhead)
Ascaridia bonasae	R	—	Small intestine (large roundworm)
A. lineata	RSP	—	Small intestine
Subulura strongylina	RS	—	Caecum

Table 3.—*Endoparasites found in sharp-tailed grouse, prairie chickens, and ruffed grouse* [1] *(continued)*

Species	Definitive host [2]	Intermediate host	Location
SUPERFAMILY SPIRUROIDEA			
Oxyspirura mansoni	R	Cockroach	Eye
O. petrowi	R	—	—
O. sp.	S	—	—
Acuaria (cheilospirura) spinosa	RS	Grasshopper	Gizzard
Physaloptera sp.	R	—	Encyst in muscles
SUPERFAMILY FILARIOIDEA			
Microfilaria sp.	R	—	Blood
SUPERFAMILY TRICHUROIDEA			
Capillaria annulata	R	Earthworms	Crop
C. contorta	PS	—	—
C. sp.	P	—	—
OTHERS (reported but not classified)			
Rhabdometra nullicollis	RSP	—	Small intestine
Seurocyrnea colini	RSP	—	Proventriculus
Dispharynx spiralis	R	Sow bug	Stomach

[1] Adapted from Edminster 1954, Boughton 1937, Bowers and Tanner 1950, Cowan and Peterle 1957, Erickson et al. 1949, Honess and Winter 1956, Morgan and Hamerstrom 1941, Spaulding 1958, and Trippensee 1948.

[2] R = Ruffed grouse, P = Prairie chicken, S = Sharp-tailed grouse.

Figure 6.—Well-managed sandhill rangeland in northeastern Colorado dominated by prairie sandreed grass, sand dropseed, and little bluestem, with sand sagebrush on the hills in the background.

soils too loose to permit farming. Where grazing is intense, the value of the habitat is also reduced.

Mixed grass prairie.—Most of the present prairie chicken habitat is mixed grass prairie. Principal grasses include western wheatgrass, needle-and-thread grass, green needlegrass, and blue grama, with local areas of little bluestem. Cordgrass occurs along the drainages. The better soils are farmed. This pattern of mixed grass with interspersed grainfields provides desirable prairie chicken habitat.

Agricultural practices have reduced the range of prairie chickens in South Dakota in recent years. Abandoned fields and pastures which support a crop of weeds and grass have provided some suitable habitat. Prairie chicken populations are highest in areas where 30 percent of the land is cultivated, 68 percent is grassland, and 2 percent supports buildings and other farm improvements (Janson 1953b).

Tall-grass prairie.—In presettlement days, the tall-grass prairie was the main habitat type occupied by prairie chickens. The primary grasses include big bluestem, little bluestem, switchgrass, and Indian grass. Most of the tall grass prairie is now under cultivation, and the birds are extremely rare. Some still do exist in parts of the tall-grass prairie where rough topography or wet soils have prevented extensive cultivation.

Lake States forest.—Prairie chickens inhabit openings within the forest types adjacent to the Great Lakes. Some of the forest openings are natural, such as large marshy areas, but most available prairie chicken habitat exists because of manmade openings—large fires, extensive logging, and land cleared for farming. The forest growth must be retarded to maintain grassland for prairie chicken habitat. Hamerstrom et al. (1957) estimated that not more than 20 to 25 percent of the area should be wooded tracts in scattered blocks.

In Michigan, prairie chickens occupy habitats consisting of a combination of cultivated fields, pastures, and wastelands with some brush and trees. On the best prairie chicken ranges, permanent grasslands make up between 17 and 33 percent of the total open land (Ammann 1957). Grange (1948) stated that the minimum area needed in Wisconsin was from 2,000 to 5,000 acres of grasslands interspersed with grainfields for winter food. The minimum continuous open area on this type needed to support a flock of prairie chickens is approximately 4 square miles.

SHARP-TAILED GROUSE

HISTORY

Skeletal elements of sharp-tailed grouse discovered in Oregon date back to the late Pleistocene Epoch (American Ornithologists' Union 1957). Wetmore (1936) reported finding a sharptail tibiotarsus dating back to approximately 1300 A.D. in a cave near Jemez Springs, N. Mex.

Since pioneering days, the sharp-tailed grouse has been a part of the animal life on the brushlands, parklands, and plains of much of the northern United States and southern Canada.

Johnson (1964) stated that sharptails probably have been in North Dakota for hundreds of years. As with the prairie chicken, sharptail numbers decreased during the drought of the 1930's, and never regained their previous high.

Intensive cultivation and overgrazing have decreased sharptail range in most Great Plains States. However, in the Lake States, clearcut logging and fires have removed coniferous forests, thus expanding the original range of sharptails. Sharptails were first recorded on Isle Royale in 1904, but the first record on the Michigan mainland was in 1922 (Baumgartner 1939). Twenty years of forest regrowth on many of these old logged and burned areas are changing the sharp-tailed grouse habitat into areas more suitable for ruffed grouse (Doll 1955).

In the Great Basin, west of the Rockies, Columbian sharp-tailed grouse were first described by Captain Lewis of the Lewis and Clark expedition in 1806 (Hart et al. 1950). Throughout the early settlement of Utah, thousands of them were observed; since then, cultivation has limited their range and numbers until only a few birds remain (Jensen 1937).

PRESENT DISTRIBUTION

Sharptails occupy suitable habitats over a huge area in North America (fig. 7). These habitats include the climax sagebrush of the northern desert shrub area, occupied by the Columbian sharp-tailed grouse; the subclimax brush in the grasslands east of the Rocky Mountains and in the parklands of the Rockies, occupied by the plains sharptail; the oak-savannah and logged or burned areas farther east inhabited by the prairie sharptail; and the openings in the boreal forest occupied by the northern sharptail, the Alaska sharptail, and other boreal forest races (Aldrich 1963).

DESCRIPTION

The sharp-tailed grouse is only slightly smaller than the greater prairie chicken. Male sharptails in South Dakota averaged 2 pounds (table 4), and females slightly under 2 pounds (Henderson 1965; Henderson and Jackson 1965).

Sharptails differ from prairie chickens in having V-shaped brown markings instead of bars on the upper breast, dusty brown instead of yellow legs, and a wedge-shaped rather than bluntly rounded

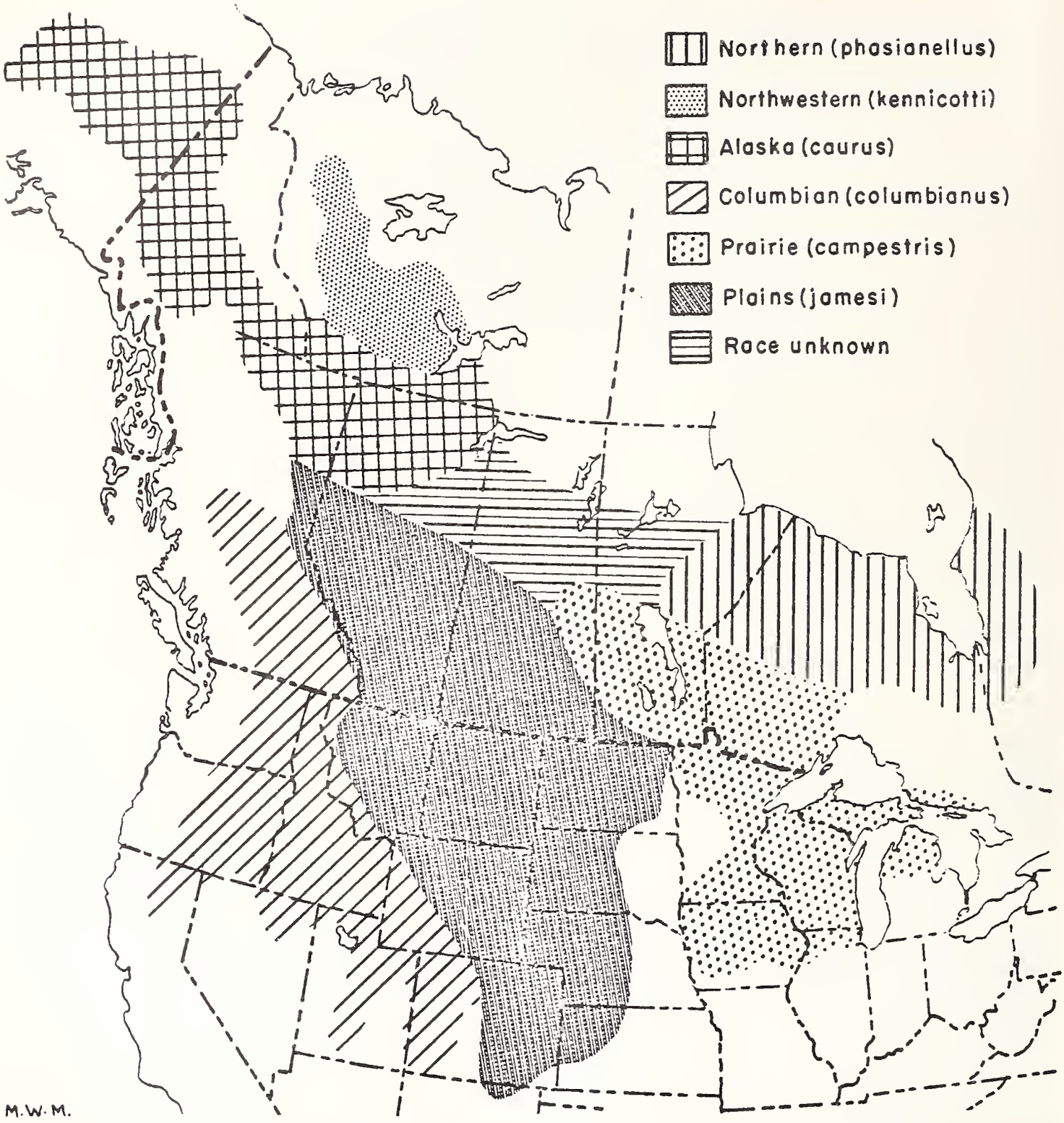

Figure 7.—Distribution of subspecies of sharp-tailed grouse in North America (Aldrich 1963).

tail (fig. 8). The tail is less than 6 inches long and shows a great deal of white in flight. The back of a sharp-tailed grouse is dark brown, and the upper wing surface is splashed with oval or round white dots. During the courtship display, the males show a purple air sac about the size of a half walnut on each side of the neck (Symington and Harper 1957). The sharptail has more tarsal feathering than the prairie chicken. Feathers on the toes of sharptails form a "snowshoe" in the winter.

Sharptails and ring-necked pheasant hens are about the same size, and are similar in color. However, the female pheasant has a plain grayish breast, a tail longer than 6 inches, and unfeathered tarsi.

In gross appearance, the male and female sharptails appear alike. The adults can be sexed by comparing markings on the two center tail feathers (the rectrix pattern, fig. 9). The males have a longitudinal color pattern, whereas females have a crossbar pattern (Symington and Harper 1957, Manweiler 1939).

Figure 8.—Sharp-tailed grouse in displaying position.

Table 4.—*Average fall and winter weights, in ounces, of over 1,500 sharp-tailed grouse in South Dakota (Henderson 1965, and Henderson and Jackson 1965)*

Date	Old		Young	
	Male	Female	Male	Female
Sept. 1960	[1] 29.8(12)	26.8(15)	25.9(42)	25.1(16)
Sept. 1961	30.2(44)	27.4(55)	29.7(89)	26.9(91)
Sept. 1962	30.1(26)	29.7(55)	27.4(25)	27.4(36)
Sept. 1963	30.4(40)	26.3(38)	28.5(114)	26.2(116)
Dec. 1963	34.4(40)	30.0(29)	32.5(41)	28.2(48)
Jan. 1964	34.1(78)	29.5(66)	33.0(151)	29.1(153)
Feb. 1964	34.5(2)	30.0(2)	32.9(26)	27.7(35)
Mar. 1964	34.2(107)	27.8(57)	33.7(236)	27.5(188)
Average ...	32.3	28.4	30.4	27.3

[1] Number in parenthesis indicates the size of the sample.

Young of all species of grouse retain the outer two primaries in the post-juvenile molt, but adults lose all their primaries during the post-nuptial molt. This provides a good aging criterion for sharptails and prairie chickens during the fall and winter. The young of the year will have a worn appearance on the next to last primary (fig. 10), whereas adult birds will have little or no wear on this primary (Ammann 1944).

Ammann (1957) reported an average age of 22 months for sharp-tailed grouse in the field. Cartwright (1944) reported the life span of sharp-tailed grouse to be approximately 3 years. The oldest known wild bird was 7½ years of age. The prairie chicken probably has a similar life span.

LIFE HISTORY

Courtship and mating.—The impressive courtship performance of the sharp-tailed grouse is similar to that of the prairie chicken in many ways. The sharptail display involves more "danc-

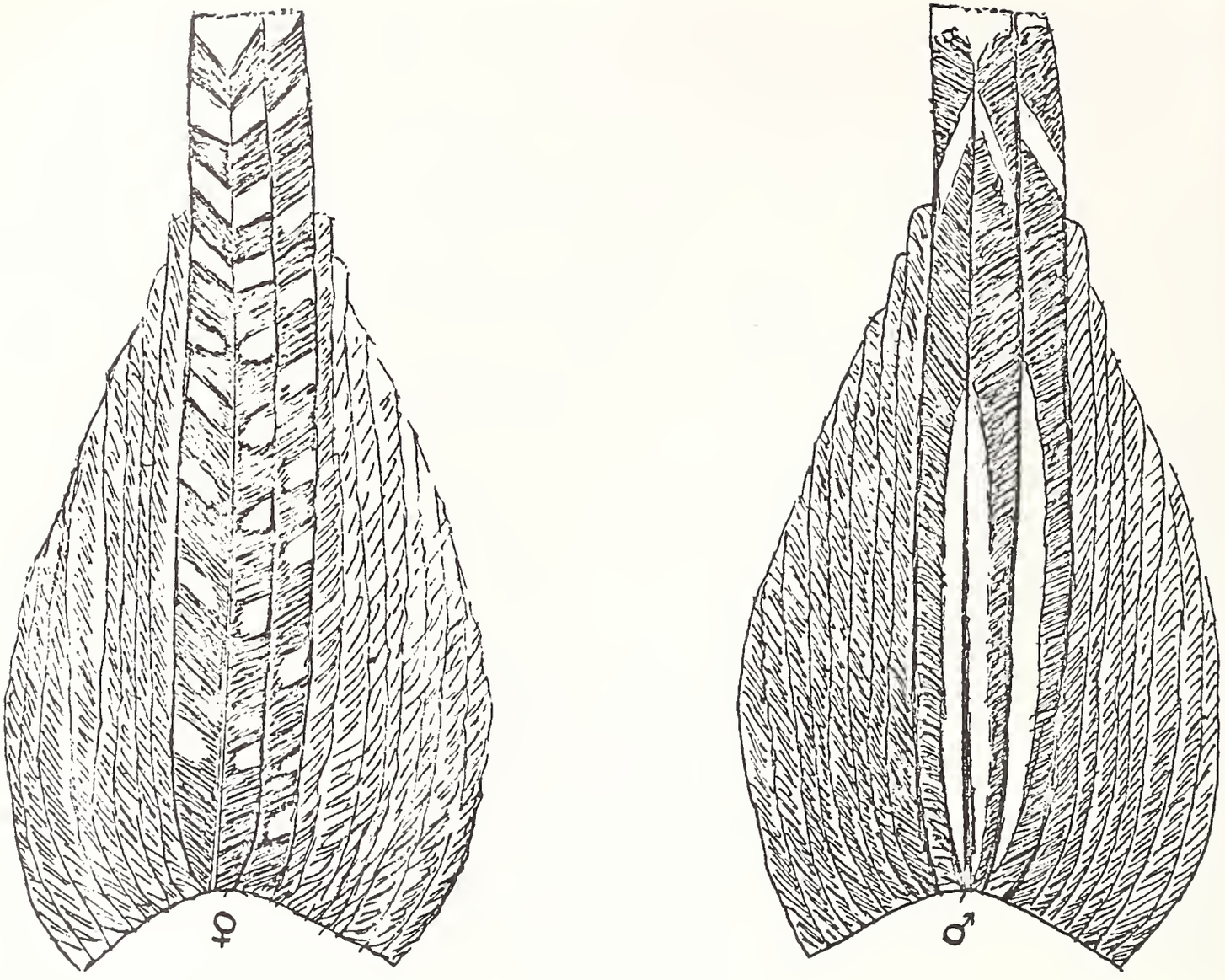

Figure 9.—The rectrix pattern in the tail feathers of sharp-tailed grouse provides a means of distinguishing sex. Tail of female grouse (*left*) is cross-barred, whereas tail of the male grouse (*right*) is longitudinally striped (after Thompson in Mosby 1960).

ing" and less vocal sound than that of the prairie chicken males. The areas of sharptail display activity are thus termed "dancing grounds." These grounds are located in open areas with short or sparse vegetation similar to prairie chicken booming grounds.

Young male sharptails first visit a dancing ground in the fall with the adult males. There is some activity throughout the fall and winter. The display activities increase in vigor and become a regular occurrence each morning as warm weather advances in the spring.

The females begin visiting the areas in late March and early April. The peak of the mating season usually occurs around the middle of April. Display activity decreases sharply toward the end of May, and does not resume until fall.

The following account of the dancing of the sharptail male is summarized from Hart et al. (1950): The male sharptail with its head thrust out straight in front, inflated purple air sacs on each side of the neck, wings extended horizontally, and tail fan-like over the back, rushes forward or rotates, stamping its feet in very rapid short steps. The showy white tail is jerked back and forth, and the wings are fluttered slightly. The bird often jumps or makes short flights into the air. The eyebrow is a showy yellow-orange and very large during courtship displays. The "dancing" and "hooting" (a sound similar to that made by a great horned owl) lasts for 30–50 seconds and then the birds "freeze" for a short period, after which the males all repeat the dance in unison.

Ammann (1957) reports that the sound of male sharptails displaying will carry for approximately one-half mile. The noise produced when the air sacs expand sounds like a cork being pulled from an empty bottle. The rattling of the tail feathers sounds like a handful of reeds being shaken. Symington and Harper (1957) describe the sound

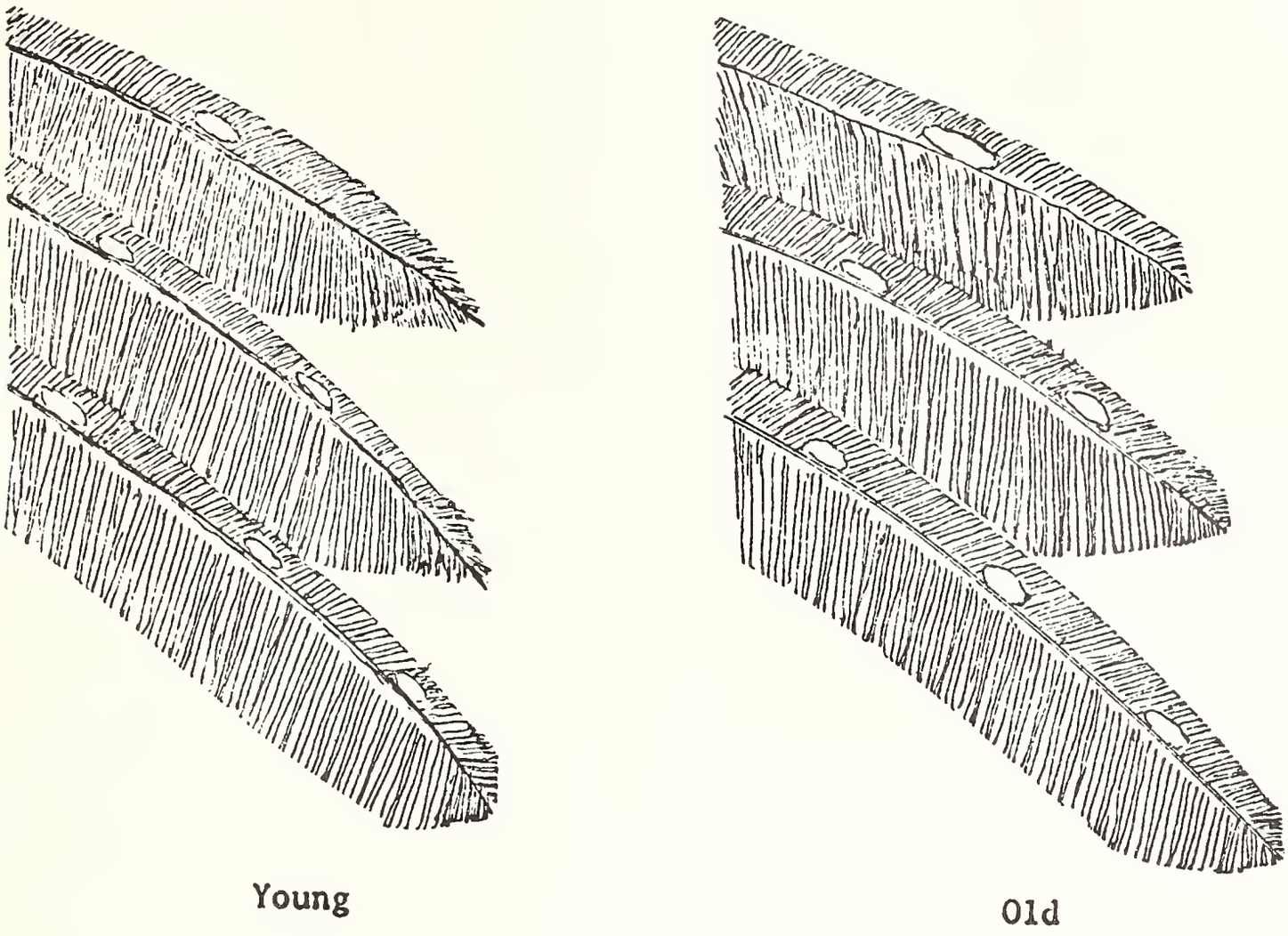

Figure 10.—The age of grouse may be determined in the fall by the worn appearance of the ninth primary of young birds. Wing of young grouse (*left*), old grouse (*right*) (Ammann 1944).

of the "hooting" and the pounding of feet on a busy dancing ground as like that of a distant waterfall.

Sharp-tailed grouse are probably promiscuous. Symington and Harper (1957) reported that sharp-tailed grouse seldom mate on the dancing ground; a hen or two may fly from the dancing ground with a male to another area where mating takes place. To the author's knowledge, this is not reported by any others. The author has observed sharptails mating on the dancing ground on several occasions.

Nesting.—The female begins nesting activities during the peak of mating activity. The nesting sites are usually chosen within one-half mile of a dancing ground. All nesting, incubating, and brood-raising are done by the female.

Most sharp-tailed grouse nests are either under some overhead cover, such as a shrub or tree, or within a few feet of such cover. The nests are similar to prairie chicken nests, and usually found near a source of seeds, buds, and berries (Ammann 1957, Symington and Harper 1957).

If the first nest is destroyed, the sharptail female may renest. The amount or importance of renesting is unknown over much of the range. Ammann (1957) reported that approximately 10 percent of the sharptail broods are produced by renesting.

During incubation, sharptail females leave the nest to feed for periods of 30 to 45 minutes each morning and evening, usually not traveling over 200 yards from the nest (Hart et al. 1950).

Eggs and incubation.—Sharptails lay a clutch of 5–17 eggs, with an average of 12. Incubation takes 21 days (Uhlig and Hamor n.d., Edminster 1954, Hart et al. 1950). Symington and Harper (1957) reported an incubation period of 23 days. The eggs of sharptails are olive to dark buff-brown in color, oval, and smooth with a slight dark purplish bloom when first laid. They average 42.6 x 32.0 mm. (1.68 x 1.28 inches). The extreme measurements on eggs are 40–45 mm. long by 30–34 mm. broad (Bent 1932, Sclater 1912, Hart et al. 1950).

Young.—The color pattern of sharptail chicks is similar to that of prairie chicken chicks. The precocious young birds leave the nest soon after hatching. The summer brood territory, consisting of grasses and low shrubs, is usually less than one-half mile across. As the birds develop, they tend to select the more brushy habitats (Edminster 1954).

Sharp-tailed grouse chicks are one-fourth grown at 4 weeks of age and can fly about 50 yards, two-thirds grown at 8 weeks and can make long flights, and fully grown at 12 weeks with full flight ability (Hart et al. 1950). At 16 weeks of age the male young of the year join the adult males for the fall display on the dancing ground (Symington and Harper 1957).

Sharp-tailed grouse are wary and strong-flying birds. Marshall and Jensen (1937) reported a flushing distance of 20–138 feet, the maximum being in the winter. Sharptails fly from 30 to 35 miles per hour, with the usual flight varying from one-fourth to one-half mile (Hart et al. 1950). Occasionally birds make much longer flights.

Movements.—Sharptails are non-migratory and both sexes commonly remain in the same general area throughout the year (Aldous 1943). The daily and annual cruising radius for sharptails varies with the area and the availability of habitat needs (table 5). From banding returns in Wisconsin and Michigan, 79 percent came from birds taken within 3 miles of the trapping site, and 69 percent were from birds within 2 miles. The longest move was 21 miles (Hamerstrom and Hamerstrom 1951a). Peterle (1956) reported that, during a trapping and tagging operation in Michigan, 10 birds were recovered by hunters in the fall. Six grouse were within 1 mile of the trapping site, two were within 3 miles, and one was 18 miles from the site. The longest sharp-tailed grouse movement recorded was 58 miles (Aldous 1943).

An extensive sharp-tailed grouse movement study, begun in 1962, is now underway in western South Dakota. From Dec. 19, 1963, through April 30, 1964, 2,392 birds were trapped, banded, and released. All were sharptails except for 19 prairie chickens and five hybrids of the two species. One female sharptail was sighted 15 miles from the release site. All other sightings of grouse on the display grounds were within 2 miles of the release site. Banded birds recovered moved between 2 and 8 miles (Jackson and Henderson 1965). Out of 145 grouse banded in 1963, 30 were observed or their bands recovered later. Three female grouse were observed at 3, 7, and 8 miles from the release site; all others were within 1 mile (Jackson 1964).

Mass emigrations of sharp-tailed grouse have been observed in Ontario and Michigan. These large-scale emigrations occurred in 1896 and 1932, when flocks moved into areas not formerly inhabited, and involved northern sharp-tailed grouse, and to a lesser extent the prairie sharp-tailed grouse (Edminster 1954).

Sex and age ratios.—Age ratios were determined on hunter-killed sharp-tailed grouse in North Dakota from 1949 through 1961. The age ratio during the hunting seasons ranged from 84 to 234 immatures per 100 adults, with the average over the 13 years being 154 young per 100 adults. The sex ratio varied from 92 to 153 males per 100 females, with an average of 113, on data collected from 1952 through 1961 (Klett 1962). Table 6 lists sex and age ratios for winter-trapped grouse in western South Dakota.

Table 5.—*Reported cruising radius for sharp-tailed grouse*

State	Miles		Source
	Daily	Annual	
Michigan ...	5	—	Baumgartner 1939
Utah	½	2	Marshall and Jensen 1937
Unknown ...	2–3	10	Uhlig and Hamor, n.d.
Wisconsin ...	1	—	Hamerstrom and Hamerstrom 1951b

Table 6.—*Age, sex, and species of grouse trapped during the winter of 1963–64 in western South Dakota (Jackson and Henderson 1965)*

Species	Old		Young		Total
	Males	Females	Males	Females	
Sharp-tailed grouse.	392	316	935	725	2,368
Prairie chicken ...	3	1	11	4	19
Hybrid-cross	1	1	2	1	5
Total	396	318	948	730	2,392

Sex ratio (males per female = 1.28
Age ratio (young per adult) = 2.35

FOOD HABITS

The general herbivorous diet of the sharptail is similar to that of the prairie chicken. The vegetative components of the diet are variable and strongly influencced by geographical and seasonal availability (Hanson 1953, Schmidt 1936, Trippensee 1948).

Sharptails utilize cultivated grains when available, but generally depend more on buds as winter food. Cultivated grains are not important to the northern sharptails, since settlement is sparse and agriculture poorly developed over much of their range. Prairie sharptails inhabit areas with a mixture of cultivated and noncultivated lands; their winter diet, therefore, (table 7, fig. 11) consists of both cultivated grain and available tree buds (Trippensee 1948).

DECIMATING FACTORS

Weather.—Weather probably has very little effect on survival of adult sharptails. Sharptails exist in extremely cold conditions near the Arctic Circle, and in areas of the Great Basin where hot dry summers are common. Undoubtedly, some adult birds are lost during hailstorms, blizzards, and ice

Table 7.—*Summary of the food habits of sharp-tailed grouse from various sources*

Main food	Area	Source
Winter—white birch, aspen, and rose hips; spring—greens of grass, forbs, and pussytoes; summer—leaves, fleshy fruits, and grasshoppers; fall—buckwheat, blackberry, bearberry, and sheep sorrel.	Wisconsin	Grange 1948
Bog cranberry, bearberry, willow, sheep sorrel, birch, and buckwheat.	Wisconsin	Schmidt 1936
Strawberry, cloves, dandelion, other herbs, insects, fire cherry, raspberry, hawthorn, rose, white birch, and aspen.	Michigan	Baumgartner 1939
Buckwheat, wild rose, wolfberry, ground cherry, poison ivy, and jack pine needles.	Minnesota	Krefting 1941
Buckwheat, snowberry, rose, bearberry, and grasshoppers.	Minnesota	Swanson 1940
Dandelion, sowthistle, saskatoon serviceberry, rose, snowberry, bindweed, aspen, chokecherry, and birch.	Saskatchewan	Symington and Harper 1957
Rose, cherry, willow, poplar, corn, and hawthorn.	North Dakota	Martin et al. 1951
Polygonum, snowberry, rose, wheat, skunkbush, poplar, chokecherry, and willow.	North Dakota	Aldous 1943
Dandelion, rose, clover, snowberry, ground cherry, and poison ivy.	Western Nebraska	Martin et al. 1951
Common dandelion, prairie rose, white clover, sweetclover, wolfberry, ground cherry, grass, and poison ivy.	Nebraska	Swank and Selko 1938
Sunflower, sagebrush, willow, poplar, chokecherry, serviceberry, and green leaves.	Utah	Hart et al. 1950
Dandelion, wheat, grass, sunflower, alfalfa, chokecherry, dock, yarrow, insects, sagebrush, and maple.	Utah	Marshall and Jensen 1937
Wild rose hips (most important), buds, greens, weed seeds, fruits, insects, and waste grain.	Unknown	Uhlig and Hamor n.d.
Rose, snowberry, smartweed, knotweed, ground cherry, white birch, bog birch, aspen, pin cherry, serviceberry, hophornbeam, increased greens in the spring, and insects.	Unknown	Edminster 1954

storms. This loss probably does not greatly reduce the population.

Weather conditions during early June are important in determining brood success. Torrential cloudbursts, and long, cold, rainy spells, during the early brood season probably reduce the nesting success of sharptails as with all ground nesters (Edminster 1954).

Predation.—Bent (1932) reported that sharptails are easy prey to coyotes while displaying in the spring. Other literature, however, does not support him. Symington and Harper (1957) concluded that the greatest predation on sharp-tailed grouse was on the nests by crows, skunks, magpies, and ground squirrels.

With such a short-lived species, the loss of one season's hatch could reduce the population by 70 to 80 percent. Three successive losses would mean virtual extermination. Cartwright (1944) suggested, therefore, that it might be beneficial for 50 percent of the first clutches to be destroyed by predation each year to stagger the hatching date, thus reducing the chance of weather to destroy the young of an entire season. This theory would be good on a species that renested readily, but there is some indication that sharptails are poor renesters. If this is so, destruction of 50 percent of the first nests would be detrimental.

Authorities agree that in most cases predation does not substantially reduce sharptail numbers. In areas of good habitat, sharptails utilize protective cover to escape most attacks by predators.

Disease and parasites.—The endoparasites reported to occur in sharp-tailed grouse are listed in table 3 under prairie chickens.

HABITAT REQUIREMENTS

Brushy cover is to sharptails what grass is to prairie chickens, second-growth is to ruffed grouse, and mature coniferous forest is to spruce grouse (Edminster 1954). Shap-tailed grouse occur throughout a large geographical area of different vegetation types. They depend on noncultivated areas to provide needed brushland. The following paragraphs describe a few characteristic habitats throughout sharptail range.

Northern sharp-tailed grouse.—This subspecies prefers a habitat of bogs, marshes, barren sand plains, frost pockets, and burned or logged clearings, where the key plants are white birch, blueberry, and aspen (Edminster 1954). It is found in open areas of the boreal forests in the Hudson Bay lowlands (Aldrich 1963).

Prairie sharp-tailed grouse.—The transition zone between farmland and forest is the habitat of prairie sharptails in the northern part of their range, and the sandhills and brushy waterways are their habitat in the southern portion. The soils vary from well-drained sandhills to wet clay soils of the northern bogs and marshes. The key plants are jack pine, red hawthorn, chokecherry, hazelnut, wild rose, sweet fern, and willow (Edminster 1954).

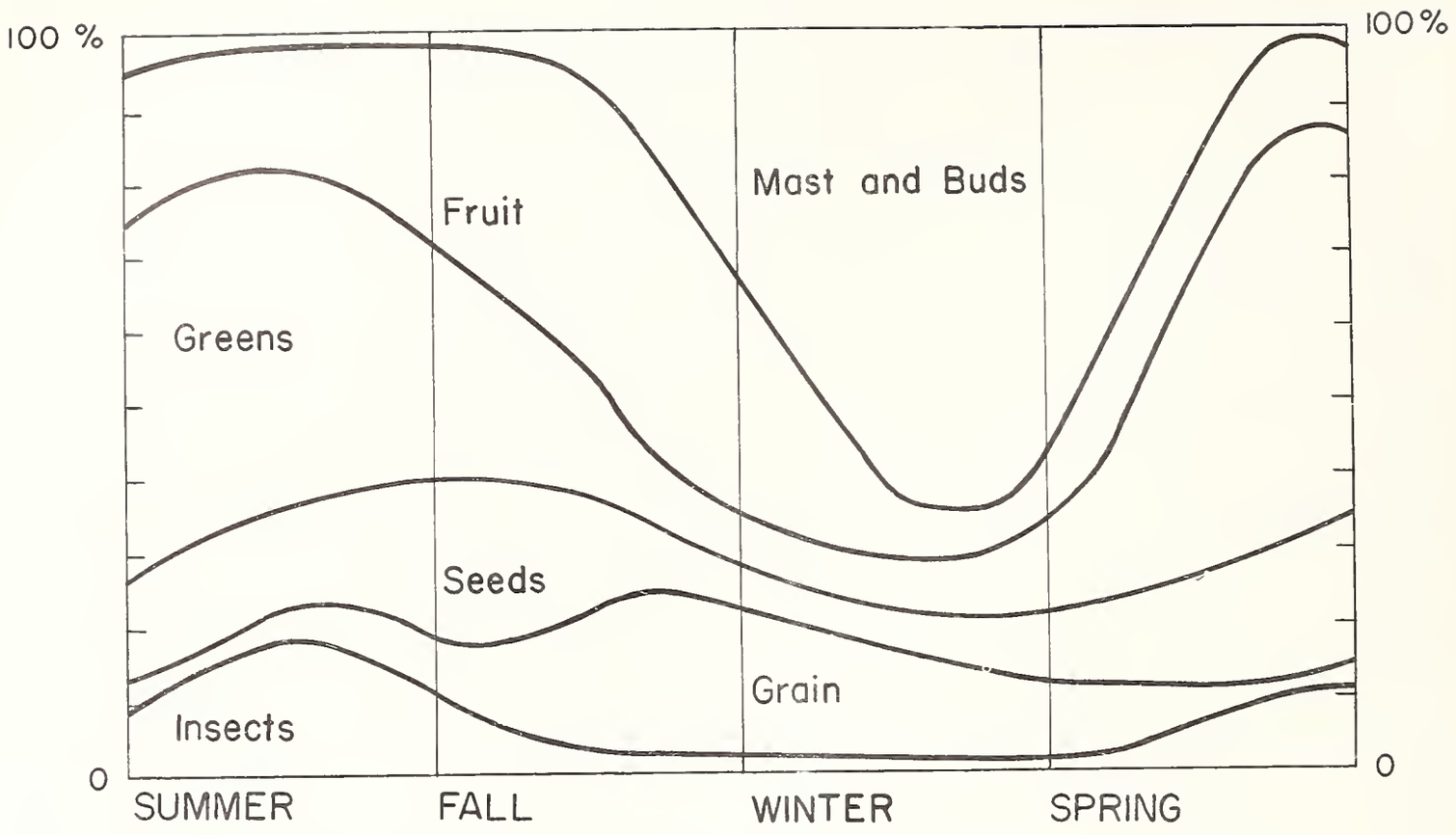

Figure 11.—General summary of the seasonal food habits of the sharp-tailed grouse (Edminster 1954).

In the Lake States, prairie sharptail need large grass areas dotted with small patches of upland hardwoods, such as poplars and birches, low brush, and scattered thickets. This type of habitat is created by burns, clear cuttings, abandoned farm clearings, frost pockets, off-site aspen growths, and open bogs (Newman 1959, Baumgartner 1939, Uhlig and Hamor n.d.). An area provides good habitat when approximately 6 percent is covered with forbs, 50 percent covered by grass and woody vegetation, and the remaining 44 percent occupied by woody cover with small openings (Ammann 1957, Uhlig and Hamor n.d.).

Columbian sharp-tailed grouse.—Suitable habitat of this subspecies in Utah consists of hills or benchlands with rolling topography and slopes of less than 50°. In some areas, overgrazing or cultivation has destroyed the habitat by eliminating native bunchgrass, forb, and shrub mixtures (Hart et al. 1950). Elevation of the habitat in western Colorado ranges from 6,000 to 9,500 feet with annual preciptation averaging between 15 and 20 inches. The key plants for sharptail habitat in the northern Great Basin area are sagebrush, chokecherry, serviceberry, hawthorn, mountain-mahogany, and wild rose (Edminister 1954).

Plains sharp-tailed grouse.—The range of plains sharptail and greater prairie chicken overlap throughout much of the northern Great Plains. The sand dune area of north central North Dakota provides good habitat for the plains sharptail. It is characterized by level to rolling topography and an annual temperature range of -50° F. to 105° F. The natural vegetation of the area consists of porcupine grass, blue grama, little and big bluestem, cordgrass, green pigeongrass slender wheatgrass, wild oats, lambsquarter, lead plant, little sage, rose, wolfberry, sunflower, marsh elder, boxelder, hackberry, bur oak, red hawthorn, Juneberry, chokecherry, juniper, aspen, and willow (Aldous 1943). Under excessive use by livestock, poison ivy becomes the dominant plant.

In Saskatchewan, Canada, the topography of the sandy areas is classified as "hump and hollow." The potholes or swales carry shrubby cover such as rose, snowberry, juniper, hawthorn, poplar, chokecherry, and willow. The loose, sandy soil prevents trees from dominating the area—when trees reach a fairly large size, they blow down (Symington and Harper 1957). Plains sharptails in eastern Colorado were observed where grass was lightly interspersed with shrubs, wheat, and trees (Rogers 1963).

The plains sharptail habitat in South Dakota is characterized by an annual average temperature of 45°F. and an annual precipitation of 15–19 inches, 75 percent of which falls between April and September (Janson 1952). The vegetation is a mixture of lightly grazed tall and midgrasses, with a scattering of cropland and brush draws. Based on a survey from 1950–58, good habitats consisted of native grass pasture less than 50 percent utilized, unmowed hayland, trees and shrubs, and weeds and low shrubs including snowberry. Habitats clas-

sified as "poor cover" were cultivated land, heavily utilized native grass, and mowed hayland. At least 30 percent of the habitat should consist of good cover; however, bird densities were progressively lower on transects with less than 49 percent of the habitat classified as good cover. Areas with 50–60 percent "good cover" seemed quite adequate, but areas with more than 70 percent "good cover" did not have correspondingly higher densities of grouse (Janson 1953b, Podoll 1955, Podoll 1957, Frary 1958, and West 1959).

The ranges of plains sharp-tailed grouse and greater prairie chicken overlap.

PRAIRIE CHICKEN AND SHARPTAIL HABITATS COMPARED

Throughout the history of settlement in North America, the environment has been modified and sharptails and prairie chickens have extended their range in some areas, but they have been eliminated from some areas of former abundance. At present, the two species inhabit the same area in several states. Both species prefer "open" country, relatively free from dense forest cover. In the winter sharptails exist on tree and shrub buds and seek cover in these habitats, whereas prairie chickens rely on grain from cultivated cereal crops for winter food.

SPRING DISPLAY AREAS

Both species prefer elevated sites with sparse and low-growing vegetation. Prairie chicken booming grounds are usually farther away from woody cover than sharptail dancing areas (Ammann 1957).

Ridgetops and knolls covered with short grass are suitable areas for prairie chicken booming grounds. Sharptails prefer a variety of cover types for spring mating activities—open cover of upland ridges and knolls for dancing grounds, but a luxuriant growth of grass, herbs, and shrubs nearby for feeding and roosting (fig. 12).

NESTING COVER

Prairie chickens prefer grassland sites for nesting, while sharptails choose a variety of sites ranging from open prairie to fairly dense woody cover with up to 75 percent crown cover. Most sharptail nests are directly under or within a few feet of overhead cover (Ammann 1957).

Medium-dense stands of midgrasses and tall grasses on well-drained sites are best for prairie chicken nesting (Hamerstrom et al. 1957, Jones 1963a, Baker 1953). Jones (1963a) reported that little bluestem was the key plant cover for nests found in Oklahoma. These nests were within a quarter of a mile of open water and a half-mile from the nearest display ground.

SUMMER AND BROOD COVER

Prairie chickens occupy open grasslands and abandoned fields where forbs are predominant throughout the summer. The insects associated with areas dominated by forbs probably play an important role in brood raising. Sharptails remain in open cover during the summer. Hamerstrom (1963) stated that openings are vitally important for brood cover: 80 percent of the brood observations were recorded in open cover, 15 percent in edge types, and only 5 percent over 50 yards into the forest type. Sharptails also utilize cultivated fields in the summer. The green material and insects associated with cultivation practices may be more important than the grains themselves.

FALL AND WINTER COVER

Prairie chickens tend to favor woody cover only during heavy snowstorms. In areas where natural woody cover is lacking, and herbaceous cover is limited because of grazing or cultivation, shelterbelts provide an important part of the winter cover. In Nebraska it was estimated that 300 shelterbelts were used by 1,000 prairie chickens during storms. Also, prairie chicken numbers increased by 36 percent on farms where shelterbelts were planted (Ordendurff 1941).

In late summer and early autumn, sharptails begin congregating into flocks of 10-30 birds, living mainly in open cover, such as upland grasses with associated other herbaceous vegetation, low scattered brush, marshy areas, or leather-leaf bogs. After the first snowfall, they form larger flocks and move into river bottoms with hardwood cover or brushy areas (fig. 13). In Utah this shift is first to sagebrush and then to maple-chokecherry after heavy snowfall (Baumgartner 1939, Marshall and Jensen 1937). Clumps of aspen and white birch bordering open fields and meadows are the major winter cover used in the Lake States (Ammann 1957, Edminster 1954, Hamerstrom and Hamerstrom 1951a).

In winter both species roost beneath snow when it is deep and powdery; prairie chickens, however, prefer dense herbaceous vegetation as roosting cover (Ammann 1957).

WINTER FOOD

Both species congregate in flocks, usually beginning in October. Flocking is more pronounced and begins earlier when birds gather at grainfields, as is common in years of fruit and berry failures. While sharptails are able to subsist through the winter on a diet of browse, berries, and seeds of wild forbs, prairie chickens over most of the Great Plains require cultivated grain. Sharptails will utilize grain when available, but they will not go far out of their way to obtain it (Ammann 1957).

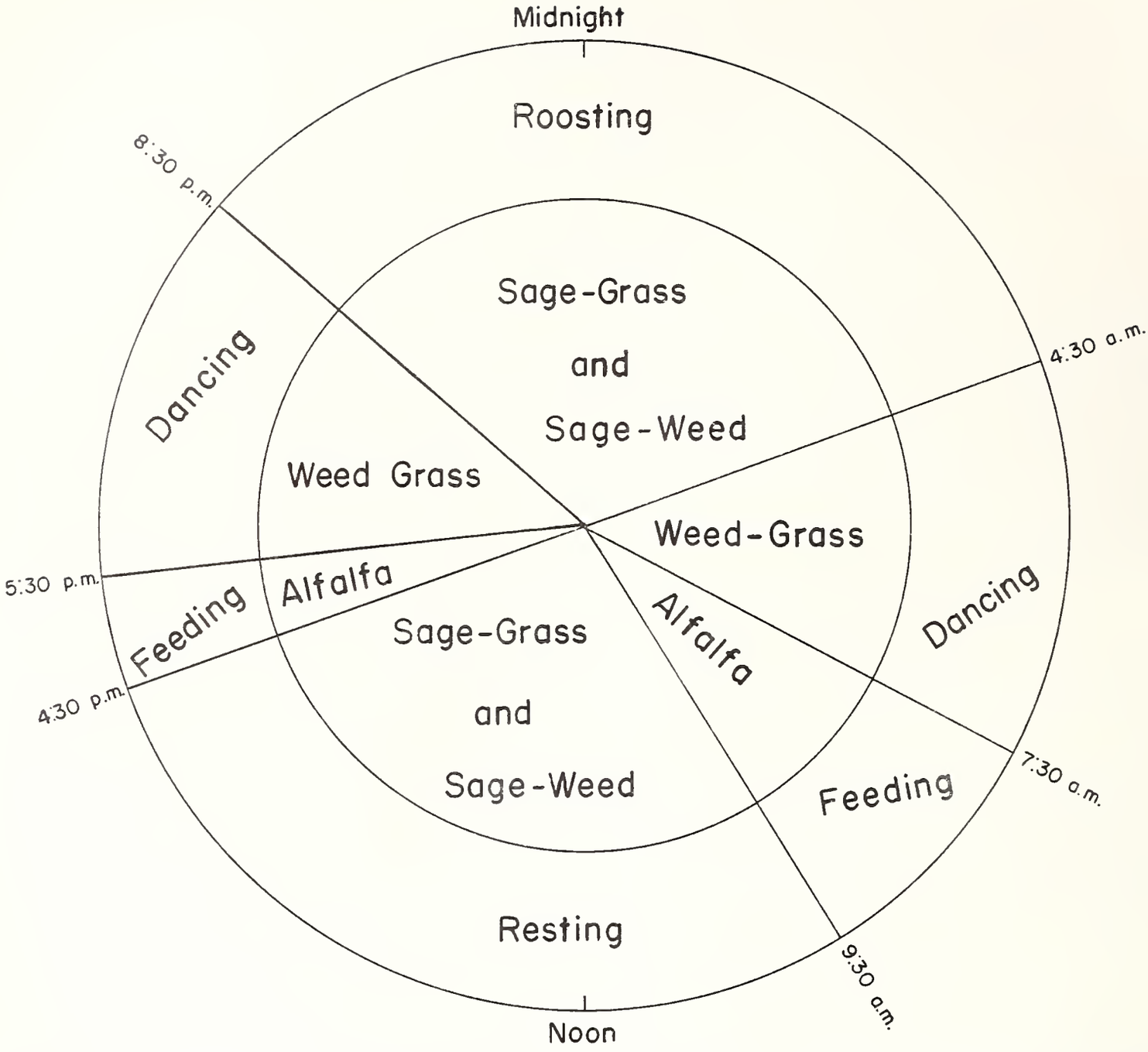

Figure 12.—Vegetation types used by sharp-tailed grouse during their daily spring activities (adapted from Marshall and Jensen 1937).

MANAGEMENT

CENSUS

The courtship and mating period is generally the best time to make trend counts of prairie grouse. The most successful method seems to be an annual count of males on the display grounds. Prairie chickens can be counted most effectively by driving along a road and observing birds along a one-mile-wide belt transect. At daybreak on a calm spring morning, the observer should drive slowly, carefully watching for birds on the horizon. While stopping to listen for the "boom" he should scan the area with binoculars (Baker 1953). A similar method can be used to census sharp-tailed grouse. Displaying sharptails make less noise than prairie chickens, however, and the observer cannot always depend on sound in locating sharptail dancing grounds.

The census of prairie grouse on spring display grounds will yield an estimate of the number of male birds per area observed. A comparison with estimates for previous years will give an index to the population trend.

Fall hunting seasons cannot be set on the basis of the display ground census only. Brood counts conducted in late June and July are also neces-

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Figure 13.—The plains subspecies of sharp-tailed grouse move into wooded river bottoms in the winter. Here they feed on buds of a green ash tree.

sary. Baker (1953) stated that, if sufficient data were available, weather conditions during nesting season might be correlated with prairie chicken reproductive success. If this is true, brood counts would not be necessary; prediction equations for fall populations could be formulated on the basis of spring display ground counts and the amount and distribution of precipitation during the hatching period from May 15 through June 15 (Baker 1953).

HABITAT MANAGEMENT

Winter is critical for the pairie chicken on the northern prairies due to the lack of available food. Because cultivated grain is a staple food during months of heavy snowfall, winter food patches could be established to bring a resident population through the winter in a healthy condition. Corn seems to be the most palatable and economic crop for winter food patches (Trippensee 1948). Schmidt (1936) stated that corn should be shocked, as prairie chickens hesitate to enter a field of uncut corn. Hamerstrom et al. (1957) disagreed, stating that standing, unpicked, yellow-dent corn makes the best food patches. They agreed that shocked corn is good, but the shocks need to be opened and new ears exposed from time to time. In Wisconsin about 1 acre of standing corn is needed to feed 30 prairie chickens through the winter. Where corn is not an important agricultural crop, buckwheat, oats, wheat, and soybeans can be substituted. To be available when needed, these crops must be harvested in the fall and distributed for the birds after heavy snowstorms (Hamerstrom et al. 1957).

Many authors have indicated that good grassland management is good prairie chicken management (Hamerstrom et al. 1957, Baker 1953, Gross 1930a). Hamerstrom et al. (1957) suggested that grass reserves be established where detrimental land use, such as overgrazing, has reduced the value of the permanent grassland. A well-managed grass reserve would provide prairie chickens with short, sparse vegetation for booming grounds and tall, lush vegetation for nesting and protective cover. For best production, less than 20 percent of the area would consist of woody cover.

Where good grassland management is practiced, the prairie chicken seems to need nothing else, except grain for winter food in the northern portion of the range. The minimum area necessary to supply prairie chickens with their habitat requirements varies, depending on the site potential of the area. Barnes (1952) estimated that 1 square mile (640 acres) of grassland is needed in Indiana. Edminster (1954) observed that from 5,000 to 10,000 acres of habitat is the minimum area required.

The key to sharp-tailed grouse management is brushland (Krefting 1941). Sharp-tailed grouse do not utilize cultivated grain for winter food as much as do prairie chickens. Schmidt (1936) recommended leaving a small patch of fast-growing aspen to provide buds as food for sharp-tailed grouse. Over much of the sharp-tailed grouse range, aspen, cottonwood, paper birch, willow, balsam poplar, or perhaps hazel grow naturally. In some areas, trees can be planted and will grow with little or no assistance after initial establishment (Trippensee 1948).

Some of the area within prairie grouse range has very little value because of overgrazing. Aldous (1943) recommended that grazing be eliminated from the sand dune area of North Dakota, and that chokecherry, rose, wolfberry, and Juneberry be planted to stabilize the sand dunes and provide cover and food for grouse and other wildlife.

In most cases, proper livestock management is not detrimental to prairie grouse habitat. In fact, light to moderate grazing prevents excessive accumulation of litter, which can reduce the value of an area as habitat.

Annual burning of rangeland should also be eliminated whenever practicable. In many instances, burning not only kills grouse and other wildlife but also is harmful to the soil. If an area must be burned, it should be done before nesting begins in the spring. Burning in the fall destroys winter cover (Trippensee 1948, Schwartz 1944). Where woody cover has a tendency to dominate an area, periodic burning can be used to maintain a grassland environment. Tester and Marshall (1962) recommend a 4-year rotation of spring burning, no treatment, grazing, and no treatment to maintain good prairie conditions in Minnesota.

POPULATION MANAGEMENT

Population management of prairie grouse, regulated by hunting seasons and bag limits, is both complicated and variable. Several States with relatively high grouse numbers (especially sharptails) have low hunting pressure, so seasons and bag limits are quite liberal. Conversely, several States have high hunting pressure and low grouse numbers (especially prairie chickens); their primary concern is to prevent overharvest.

North Dakota has high grouse numbers and low hunter density; therefore, Klett (1958) recommended that the sharp-tailed grouse season be opened in mid-September, because young sharptails mature early and provide the best hunting before large flocks are formed in the fall. More birds are harvested if the season is opened before the pheasant and waterfowl seasons, as contrasted to simultaneous seasons.

Where prairie chickens are scarce, seasons should coincide with those of pheasant, sharp-tailed grouse, ruffed grouse, or waterfowl to distribute the hunters. Otherwise, hunter concentrations in areas with high grouse numbers may result in an overharvest of prairie chickens (Baker 1953, Hamerstrom et al. 1957). Baker (1953) suggested a permit system of hunting prairie chickens. The permits could be distributed in accordance with the population numbers of different areas.

Another way to prevent overharvesting would be to establish small refuge areas throughout the range of the prairie chickens. This probably could be accomplished on lands in private ownership. In many areas, the landowners "post" enough land to serve as refuges even without encouragement from game and fish departments (Baker 1953).

Hunting regulations become very important in managing animals with a low population density. No State has managed prairie grouse intensively enough to develop a formula for the amount of hunting pressure which should be exerted each year; the basic problem of setting hunting seasons and bag limits for a fluctuating game species has not been solved. Hamerstrom et al. (1957) believed that 25 to 35 percent of the population could be harvested during peak levels. When the population drops below 50 percent of peak levels, the season should be closed.

ARTIFICIAL PROPAGATION AND STOCKING

Like most grouse, prairie chickens do not subsist well in captivity. Similar problems probably occur with sharptails. Birds raised in captivity may be needed, however, for future restocking of areas where they have vanished. Where possible, wild birds should be trapped for restocking programs. Coats (1955) listed the following characteristics as important to raising prairie chickens in captivity:

1. Chicks inspect food at eye level, not on the ground.
2. Chicks react only to moving insects as food.
3. Chicks are more apt to find water if it is sprayed on a screen in droplet form than if it is standing in a pan.
4. Chicks are more inclined to search for food if they have ingested a good quantity of water.

Handley (1935) started with a clutch of 23 eggs, and was successful in hatching 16. He raised 8 to maturity. Rickets developed in chicks fed skimmed-milk clabber, but not in those fed whole-milk clabber. Grasshoppers proved to be good feed for young chicks. Hornbeck (1958) also successfully raised prairie chickens in captivity from eggs collected from the wild.

MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS

Recommendations for the management of sharp-tailed grouse differ in many cases from those for prairie chickens. Also, recommendations vary from one location to another. The following general recommendations for greater prairie chicken and sharp-tailed grouse management and research needs have been summarized from Evans (1964), Yeatter (1963), Ammann (1957), Hamerstrom et al. (1957), Edminster (1954), Baker (1953), the National Committee on the Prairie Chicken (1953), and Schwartz (1944):

1. Census adult populations of prairie grouse on display grounds each spring to ascertain trends in numbers.

2. Count young birds between June 15 and August 15 each year to determine reproduction success.

3. Permit controlled hunting of prairie grouse during the fall on areas which support shootable populations.

4. Establish hunter check stations at important locations to aid in determining age and sex ratios and movement patterns.

5. Encourage the preservation of existing prairies and brushlands and the revegetation of areas regarded as unsuitable for cultivation or timber production.

6. Establish refuges in areas where prairie chicken nesting cover such as big bluestem, little bluestem, switchgrass, and Indian grass is lacking. An effective refuge contains approximately 25 percent of the total area in scattered 20- to 40-acre plots in native or reseeded tall grasses.

7. Establish food patches in areas where winter food is lacking (especially in the northern and western range of the prairie chicken). Standing, unpicked yellow-dent corn seems to be best. These food patches should remain in the same place year after year.

8. Discourage annual burning of rangeland. Controlled fire is sometimes useful, however, in opening a dense stand of noncommercial trees, and thus encouraging shrub and grass growth.

9. Coordinate prairie chicken and sharp-tailed grouse management where their ranges overlap.

10. Undertake research on prairie grouse population characteristics and competitive relationships which are needed for management.

11. Study the specific habitat requirements of the sharptail and prairie chicken to differentiate between ideal and marginal habitats, and to determine ways of improving marginal habitats.

12. Encourage research on the movements of prairie grouse. Information is lacking on distance of movements and reasons for them. The accuracy of the spring census of displaying grouse could be improved by knowing how often a male visits the display ground, and whether he will visit more than one display ground during the mating season.

13. Conduct cooperative research to determine livestock grazing patterns that would benefit both the rancher and the prairie grouse. Overgrazing is probably the most serious factor in limiting prairie grouse numbers.

14. Encourage research pertaining to grouse diseases and parasites, and their effect on grouse populations. Also, very little is known concerning the relationship between grouse habitat types and occurrence of parasites.

SUMMARY

Sharp-tailed grouse have long been a desirable part of the animal life on the brushlands, parklands, and plains of much of northern United States and southern Canada. Records indicate that prairie chickens were originally native only to the tall-grass prairies of central and eastern United States. Prairie chickens were scarce or entirely absent on much of the Great Plains in presettlement days, but became abundant soon after agricultural development provided them with winter food. At present, prairie chickens occupy portions of the grasslands of central United States and south central Canada. Sharp-tailed grouse occupy brushy habitat from Nevada, Colorado, Nebraska, Wisconsin, and Michigan, north to Alaska.

The greater prairie chicken, a hen-sized grouse averaging two pounds in weight, is identified by its rounded tail and heavily barred underparts. The sharptail is slightly smaller, and is identified by its wedge-shaped tail, dusty brown legs, and V-shaped brown markings on the upper breast.

With the advent of warmer weather in late winter or early spring, the male prairie grouse leave the winter flocks and begin visiting display grounds. Courtship displays and mating continue each morning throughout the spring. The birds return to the same area for their courtship displays year after year. Most nests are located within one-half mile of the nearest display area. Female prairie chickens prefer a medium dense stand of midgrasses and tall grasses for nesting; sharptail hens usually select a nesting site either under or near some type of brushy overhead cover. Hatching reaches its peak between June 1 and 15, after a 22- to 24-day incubation period. The young are precocious and ready to leave the nest as soon as their down dries. During late fall and early winter, prairie grouse begin forming flocks. Though considered to be nonmigratory, they will move a considerable distance in search of winter food.

Prairie grouse, like other members of the grouse family, are primarily herbivorous. The exception is in the juvenile stage, when as high as 80 to 90 percent of the diet is animal material—mostly insects. While sharptails can exist through the winter on buds, mast, and weed seeds, prairie chickens need wheat, corn, or other cultivated crops to provide winter food, except on the tall-grass prairie.

Permanent grassland is essential for prairie chicken survival; brushland is needed for sharptails. Both species prefer elevated, open sites for their courtship displays, and remain in open vegetation throughout the summer. Sharptails utilize shrubs and trees during the winter for food and cover. Prairie chickens tend to favor woody cover only during heavy snowstorms. Sharptail habitat can be sustained or improved by maintaining a high-quality grassland with patches of brush or trees. Winter is critical for prairie chickens due to the lack of available food. Corn seems to be the most palatable and economic crop for winter food patches. Yellow-dent corn makes the best food, and for maximum effectiveness should be left standing and unpicked.

Limited information has been published on managing prairie grouse populations. Extensive research is needed to determine sex and age ratios, densities, and other information required for management. Where prairie grouse are locally abundant, strictly controlled hunting should be permitted. Experience has indicated that lack of suitable habitat, rather than hunting or predation, limits expansion of grouse populations. Major efforts should therefore be made to understand the habitat requirements of these game birds, and to learn how to improve marginal habitats.

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APPENDIX

SCIENTIFIC AND COMMON NAMES OF PLANTS AND ANIMALS MENTIONED [3]

Grass

Agropyron smithii	Western wheatgrass
Agropyron trachycaulum	Slender wheatgrass
Andropogon gerardi	Big bluestem
Andropogon hallii	Sand bluestem
Andropogon scoparius	Little bluestem
Avena fatua	Cultivated oats
Bouteloua gracilis	Blue grama
Calamovilfa longifolia	Prairie sandreed
Carex spp.	Sedges
Hordeum vulgare	Barley
Panicum virgatum	Switchgrass
Secale cereale	Rye
Setaria viridis	Green pigeongrass
Sorghastrum nutans	Indian grass
Sorghum vulgare	Sorghum
Spartina pectinata	Prairie cordgrass
Sporobolus cryptandrus	Sand dropseed
Stipa comata	Needle-and-thread grass
Stipa spartea	Porcupinegrass
Stipa viridula	Green needlegrass
Triticum sp.	Wheat
Zea mays	Corn

Shrubs and Trees

Acer negundo	Boxelder
Acer sp.	Maple
Alnus sp.	Alder
Amelanchier alnifolia	Saskatoon serviceberry
Amelanchier sp.	Serviceberry and Juneberry
Arctostaphylos uva-ursi	Bearberry
Artemisia filifolia	Sand sagebrush
Artemisia sp.	Sagebrush
Betula glandulosa	Bog birch
Betula nigra	Black birch
Betula papyrifera	Paper birch
Betula pendula	White birch
Celtis occidentalis	Hackberry
Cercocarpus montanus	Mountain-mahogany
Chamaedaphne calyculata	Leather-leaf
Cornus sp.	Dogwood
Corylus sp.	Hazel and hazelnut
Crataegus sp.	Hawthorn
Fraxinus pennsylvanica	Green ash
Juniperus sp.	Juniper
Malus pumila	Apple
Ostrya virginiana	Hophornbeam
Pinus banksiana	Jack pine
Pinus sp.	Pine
Populus balsamifera	Balsam poplar
Populus sp.	Poplar and cottonwood
Populus tremuloides	Aspen
Prunus pensylvanica	Pin cherry
Prunus sp.	Fire cherry
Prunus virginiana	Chokecherry
Quercus macrocarpa	Bur oak
Rhus radicans	Poison ivy
Rhus trilobata	Skunkbush
Rosa spp.	Rose
Rubus spp.	Blackberry and raspberry
Salix sp.	Willow
Symphoricarpos albus	Snowberry
Symphoricarpos occidentalis	Wolfberry
Ulmus spp.	Elm
Vaccinium angustifolium	Lowbush blueberry
Vaccinium sp.	Cranberry (Blueberry)

Forbs

Achillea sp.	Yarrow
Ambrosia sp.	Ragweed
Amorpha canescens	Leadplant
Antennaria sp.	Pussytoes
Chenopodium album	Lambsquarter
Comptonia peregrina	Sweet fern
Fagopyrum spp.	Buckwheat
Fragaria sp.	Strawberry
Glycine max	Soybean
Helianthus sp.	Sunflower
Iva sp.	Marsh elder
Lespedeza stipulacea	Korean lespedeza
Medicago sativa	Alfalfa

[3] Common names as listed by authors cited in this report. Scientific names from Hall (1965), Gleason (1963), American Ornithologists' Union (1957), Harrington (1954), Burt and Grossenheider (1952), and Hitchcock (1950).

Melilotus sp.	Sweetclover
Physalis sp.	Groundcherry
Polygonum convolvulus	Black bindweed
Polygonum spp.	Knotweed and smartweed
Rumex acetosella	Sheep sorrel
Rumex venosus	Dock
Smilax sp.	Greenbrier
Sonchus sp.	Sowthistle
Taraxacum officinale	Dandelion
Trifolium repens	White clover
Mammals	
Canis latrans	Coyote
Citellus spp.	Ground squirrel
Lynx rufus	Bobcat
Mephitis meplitis	Skunk
Mustela frenata	Weasel
Mustela vison	Mink
Urocyon sp. and *Vulpes* spp.	Fox
Birds	
Accipiter gentilis	Goshawk
Accipiter striatus	Sharp-shinned hawk
Bonasa umbellus	Ruffed grouse
Bubo virginianus	Great-horned owl
Buteo lagopus	American rough-legged hawk
Canachites canadensis	Spruce grouse
Circus cyaneus	Marsh hawk
Corvus brachyrhynchos	Crow
Falco mexicanus	Prairie falcon
Lagopus lagopus	Willow ptarmigan
Lagopus mutus	Rock ptarmigan
Pedioecetes phasianellus	Northern, Mackenzie, Alaska, Columbian, prairie, and plains sharp-tailed grouse; other names include prairie chicken, prairie hen, pintailed grouse, sprig-tailed grouse, fire grouse, and brown legs.
Phasianus colchicus	Pheasant
Pica pica	Magpie
Tympanuchus cupido	Heath hen, greater prairie chicken, Attwater's prairie chicken, prairie chicken, prairie hen, squaretail, sage chicken, yellow legs, and pinnated grouse
Tympanuchus pallidicinctus	Lesser prairie chicken

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